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AMERICAN DYESTUFF REPORTER

A. P. HOWES
Publisher

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Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

JUNE 9, 1941

VOLUME 30 NUMBER 12

American Dyestuff Reporter, Vol. 30, No. 12, June 9, 1941. Published every other Monday. Copyright, 1941, by Howes Publishing Co., 440 4th Ave., New York, N. Y. Domestic subscription, $5.00, Canadian, $6.00, Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Special Articles

Physical Properties of Cotton Corduroy for Boys' Clothing 295
Gladys White

• Departments

Trade Notes—New Products..... 311

Technical Notes from Foreign Sources..... 313

• Proceedings of the American Association of Textile Chemists and Colorists

Calendar of Coming Events..... P299

Vat Dyes on Mixed Fibers..... P300
Ormond W. Clark

Fire Retardant Treatments for Textiles..... P305
Dr. W. E. Gordon

Meeting, Piedmont Section..... P308

Inspectors Wanted P308

Meeting, Southeastern Section..... P308

Technical Program, Annual Meeting..... P309

Unemployment Register P309

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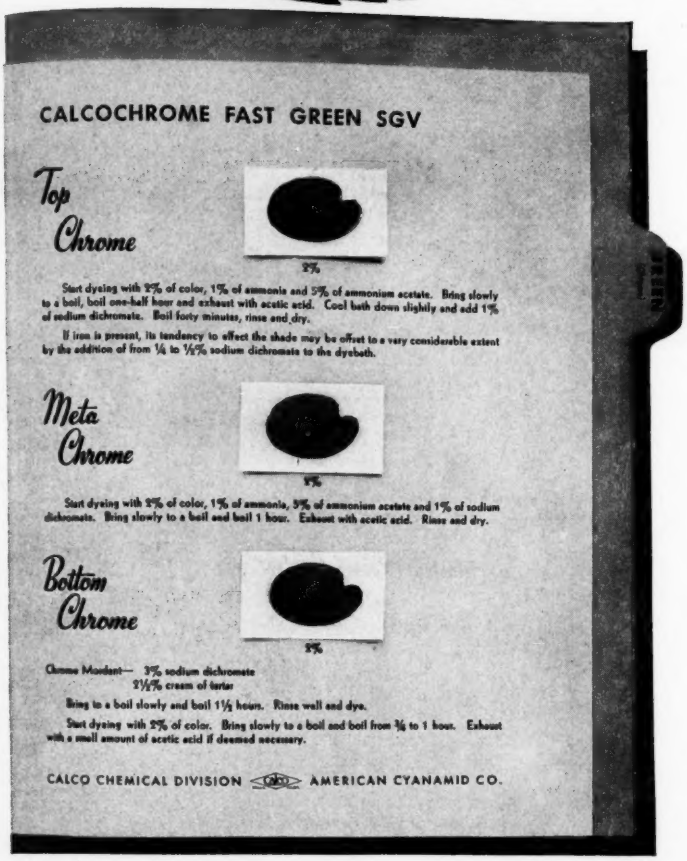
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DYESTUFF REPORTER

VOLUME 30 JUNE 9, 1941 NUMBER 12

Physical Properties of COTTON CORDUROY for Boys' Clothing

GLADYS WHITE*

IN spite of a growing interest in informative selling, few facts are as yet available about textiles from the angle of consumer requirements. This study of the physical characteristics of cotton corduroy was undertaken by the Bureau of Home Economics to assist purchasers in selecting qualities best suited for boys' clothing. Efforts were made to obtain as many different constructions of corduroy as possible. Only a few types were found which were designated or seemed appropriate for boys' wear although numerous colors and styles were available. The fabrics chosen were tested for breaking strength, weight, durability as measured by resistance to abrasion, colorfastness to light and to washing, changes produced by laundering, and other physical properties which might interest consumers.

MATERIALS AND METHODS

Four-yard pieces of 12 cotton corduroy fabrics were purchased directly from manufacturers. Three different types of construction of ground weave were represented by the 12 fabrics. Four fabrics (Nos. 1, 2, 3 and 4) had a plain ground weave. The w-pile yarns of fabrics 1 and 2 and the v-pile yarns of 3 and 4 were woven into the fabric as shown in Figure 1 (a) and (b) respectively. Four fabrics (Nos. 5, 6, 7, and 8) had two paired and one single warp yarn and single filling in the ground with w-pile yarns woven as shown by Figure 2. The four remaining fabrics (Nos. 9, 10, 11, and 12) had paired warp yarns and single filling in the ground with w-pile yarns woven as in Figure 3. Fabrics with the construction shown in Figures 1 (a) and (b), 2 (a) and 3 (a) had an approximate filling count, including the pile yarns, of three times the filling count of the ground yarn, and those in Figures 2 (b) and 3 (b) had four times this filling count.

For purposes of testing, the four yards of each fabric were cut into four sections, two 29 inches in length and two

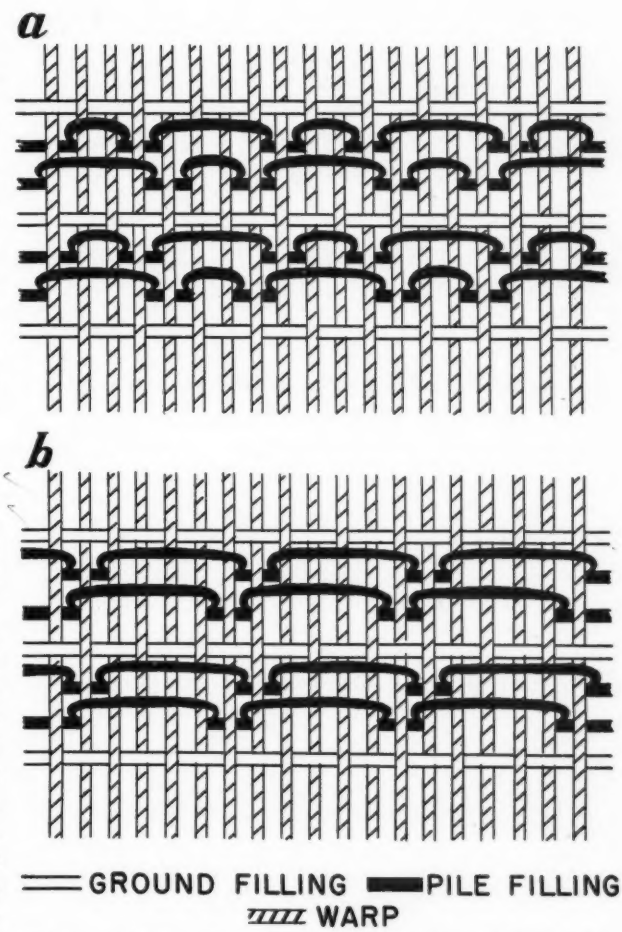

Figure 1—Arrangement of filling pile yarns in corduroy fabrics with plain ground weave: (a) w-pile; (b) v-pile. In each of these diagrams the uncut pile yarn is shown; whereas, in finished corduroy the longer float has been cut to produce the characteristic tufts.

43 inches. All fabrics were approximately 36 inches wide. The two 29x36-inch blocks were cut from opposite ends of the piece and were used for duplicate sets of

*Assistant textile physicist, Division of Textiles and Clothing Bureau of Home Economics. Appreciation is expressed to O. A. Pope, *associate agronomist*, Bureau of Plant Industry, for helpful suggestions on the statistical analyses of this paper. Acknowledgment is made to Bess Viemont Morrison, *assistant home economics specialist*, Bureau of Home Economics, for grading abraded and colorfastness samples.

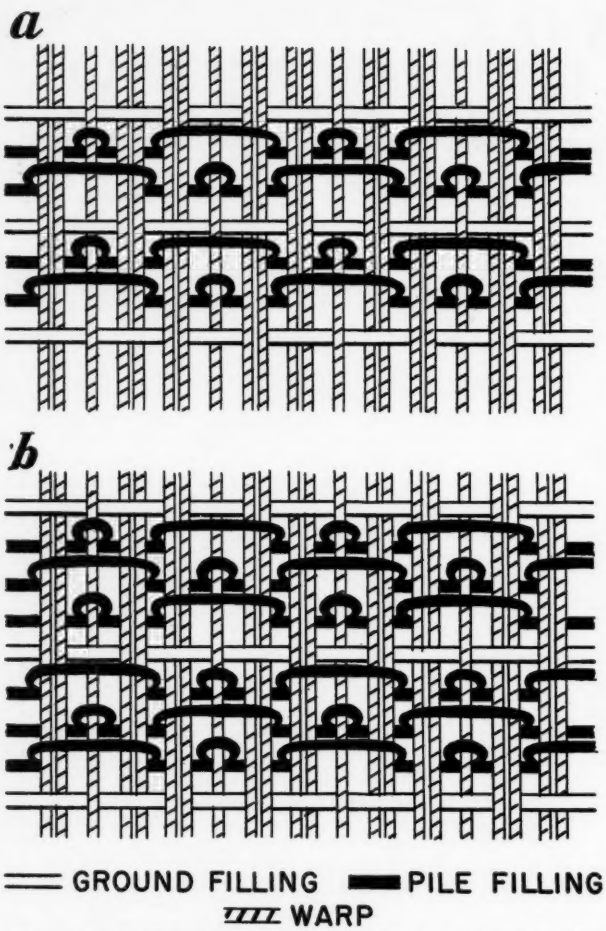

Figure 2—Arrangement of filling pile yarns in corduroy fabrics with two paired and one single warp yarn and single filling in the ground weave: (a) w-pile with two pile yarns to every ground filling yarn; (b) w-pile with three pile yarns to every ground filling yarn. In each of these diagrams the uncut pile yarn is shown; whereas, in finished corduroy the longer float has been cut to produce the characteristic tufts.

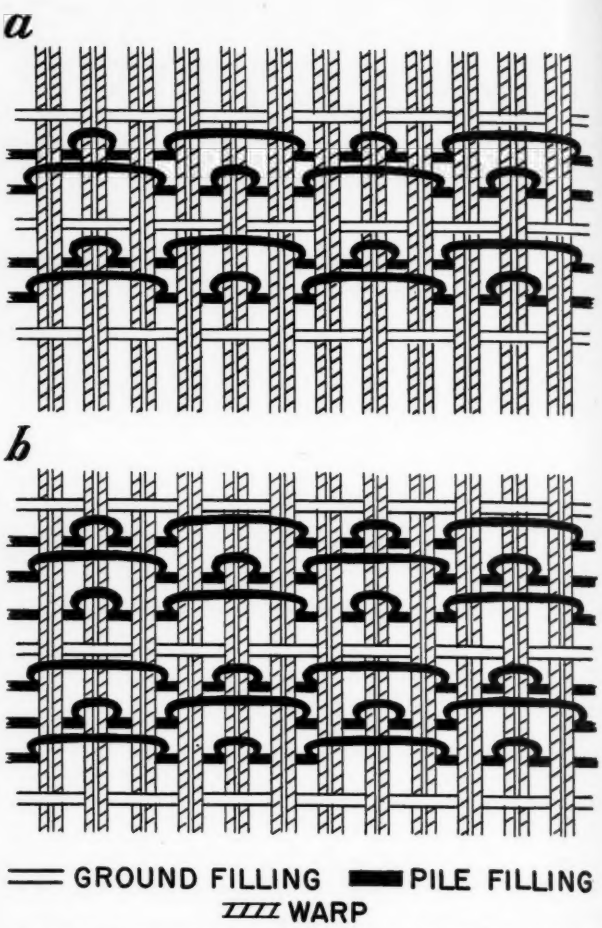

Figure 3—Arrangement of filling pile yarns in corduroy fabrics with paired warp yarns and single filling in the ground weave: (a) w-pile with two pile yarns to every ground filling yarn; (b) w-pile with three pile yarns to every ground filling yarn. In each of these diagrams the uncut pile yarn is shown; whereas, in finished corduroy the longer float has been cut to produce the characteristic tufts.

determinations on the new fabric. Each block furnished ten samples for breaking strength by the strip method, count, and yarn number of ground yarns; five for weight, thickness, compressional resilience, number and weight of tufts per square inch, and breaking strength by the grab method; one for determination of percentage of sizing material, and colorfastness to light and to washing. Samples were taken from positions in which no yarns were duplicated.

Likewise the two 43x36-inch blocks were used for duplicate sets of determinations on the laundered fabric. These pieces were washed by a standard method of determining shrinkage[1]. Two departures from this method were necessary because of the equipment available. A soap solution of 70° was used instead of 100° C. and the machine was stopped between each change of water instead of being run continuously during the 60 minutes of washing. Each block furnished five samples for breaking strength on the washed and on the abraded fabric, count, weight, thickness, and number and weights of tufts per square inch; and one sample for determination of percentage of shrinkage.

Standard methods of testing were used whenever possible. Breaking strength, count, weight, and percentage of sizing material determinations were made according to methods published by the American Society for Testing Materials[2]. The standard method outlined in Commercial Standard CS59-39[1] was followed for tests of colorfastness to laundering and also to light. However, the samples tested for colorfastness to light were exposed to a carbon arc for 20, 40, and 80 hours instead of the two periods designated in the standard. Yarn numbers were obtained by means of a yarn numbering balance. Thickness and compressional resilience were determined with a compressometer. One-inch squares were used for determinations of number and weight of tufts per square inch.

Tests of resistance to abrasion were made on a Wyzenbeek tester with the samples under 3 pounds pressure and 2 pounds tension. A stainless steel gauze was used as the abradant. The fabrics were rubbed 15,000 times in the

warp direction and 5,000 times in the filling direction, and thickness determinations were made both before and after this abrasion. The abraded areas were examined visually and rated according to the amount of wear. Samples rubbed in the warp direction were tested for filling breaking strength and those rubbed in the filling direction were tested for warp breaking strength. The grab method of test was followed in all cases.

RESULTS

Physical properties of the new and laundered fabrics are recorded in Tables 1, 2, and 3. Means are given of determinations from the two blocks representing different locations within the fabric. From these it will be noted that the new fabrics differed widely in nearly all physical properties. An exception was the compressional resilience. The amount of finishing material was surprisingly high in

TABLE 1

Physical properties of new cotton corduroy fabrics

Fabric	Type of pile	Ribs per inch	Weight		Count			Tufts per square inch†	Standard thickness	Compressional resilience	Yarn number		Loss in weight on desizing
			Whole fabric	Tufts	Warp	Filling	Filling plus pile yarns*				Warp	Filling	
		Number	Ounces per square yard	Ounces per square yard	Number	Number	Number	Number	Inches	Percent	1,000 yards per pound	1,000 yards per pound	Percent
1	W	17	6.33	3.32	66	64	191	1056	0.0336	20	27.02	34.02	2.2
2	W	16	6.52	3.11	66	60	179	978	.0335	16	21.48	33.88	2.9
3	V	8	9.96	4.97	49	38	115	624	.0498	16	14.88	10.22	19.4
4	V	8	11.32	6.24	48	31	93	498	.0596	18	13.25	8.14	16.5
5	W	12	12.43	6.86	57	35	141	604	.0486	18	12.56	11.02	17.2
6	W	12	12.07	6.04	61	46	139	563	.0484	20	13.20	10.80	13.2
7	W	12	11.98	5.62	60	46	137	549	.0560	15	12.38	12.02	9.2
8	W	12	12.27	6.00	60	47	141	565	.0581	16	12.34	11.62	6.3
9	W	11	12.24	6.91	68	38	152	648	.0499	19	14.92	12.30	12.4
10	W	11	12.20	7.10	66	37	148	618	.0544	19	15.71	11.95	11.5
11	W	11	11.39	6.60	69	35	141	604	.0544	17	14.34	11.52	13.5
12	W	11	14.60	7.43	68	48	143	536	.0538	17	12.98	9.41	13.5

*Calculated from the filling count of the fabric.
†Calculated from the warp and filling count of the fabric.

TABLE 2

Physical properties of laundered cotton corduroy fabrics

Fabric	Weight		Count		Tufts per square inch*	Standard thickness			Shrinkage	
	Whole fabric	Tufts	Warp	Filling		Washed fabric	Abraded fabric Warpwise	Abraded fabric Fillingwise	Warp	Filling
	Ounces per square yard	Ounces per square yard	Number	Number	Number	Inches	Inches	Inches	Percent	Percent
1	6.52	3.17	70	67	1169	0.0403	0.0380	0.0332	3.2	2.0
2	6.22	2.63	65	62	1008	.0400	.0352	.0342	3.8	1.0
3	8.74	4.16	52	40	691	.0569	.0522	.0522	4.2	7.7
4	10.21	5.51	49	32	522	.0700	.0340	.0641	4.2	3.9
5	11.05	5.91	59	38	674	.0602	.0465	.0532	2.9	3.2
6	11.21	5.58	63	46	589	.0598	.0537	.0548	2.9	7.6
7	11.30	4.58	62	49	603	.0641	.0596	.0568	3.6	1.6
8	11.92	5.18	62	50	618	.0656	.0622	.0578	3.4	3.0
9	11.06	5.50	68	41	694	.0614	.0574	.0542	3.7	1.9
10	11.53	5.74	68	39	664	.0665	.0478	.0606	3.8	3.4
11	10.77	5.67	73	38	688	.0621	.0576	.0548	2.8	5.8
12	12.87	5.63	68	49	556	.0630	.0552	.0568	2.6	0.8

*Calculated from the warp and filling count of the fabric.

TABLE 3

Breaking strength in pounds of new and laundered cotton corduroy fabrics

Fabric	Strip method				Grab method							
	New fabric				New Fabric				Laundered fabric			
	Mean		Standard deviation		Mean		Standard deviation		Mean		Mean after abrasion	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
1	47.5	38.8	1.6	2.3	51.8	46.9	0.6	3.0	50.1	52.5	52.2	50.0
2	55.8	33.9	2.1	3.4	59.9	40.4	1.3	4.8	60.4	43.6	61.2	42.4
3	60.3	50.2	3.0	4.4	70.5	62.0	2.9	4.5	55.5	54.5	59.7	58.8
4	57.9	50.8	2.1	4.1	68.2	62.8	3.3	2.6	58.2	59.1	56.2	54.8
5	77.9	46.4	2.2	2.8	87.2	64.	2.8	4.5	78.1	60.7	78.2	58.9
6	70.2	52.3	2.2	4.7	76.9	71.6	6.8	4.0	79.4	69.8	78.2	66.7
7	86.6	49.0	3.0	3.7	97.6	69.1	3.9	4.2	88.8	69.5	89.2	66.8
8	83.0	56.3	2.3	3.4	93.2	77.6	2.7	4.1	100.4	79.8	96.6	78.0
9	75.2	43.9	2.0	2.9	84.2	60.8	1.8	5.2	80.3	60.4	79.6	61.2
10	63.3	45.3	1.7	1.8	72.2	64.2	2.5	2.2	68.6	58.9	66.0	51.8
11	72.9	39.3	3.6	1.9	83.6	51.6	6.6	0.9	68.9	48.2	65.6	47.1
12	78.3	67.6	2.6	4.8	88.8	96.8	2.3	7.3	76.9	81.5	72.9	81.2

most cases. Variations in breaking strength were fairly large for many fabrics as shown by their standard deviations. The weight of the majority of fabrics was divided into approximately a 50:50 ratio between ground fabric and tufts.

Fabrics 1 and 2 had a larger number of ribs per inch and tufts per square inch, a higher filling count, were lighter in weight and thinner, had finer yarns, and a smaller percentage of sizing than the other fabrics. These two fabrics are not used as frequently in boys' clothing as in garments for young children and adults. Fabrics 3 and 4 were the only fabrics with v-pile. They had the smallest number of ribs per inch, and lowest warp count and filling count when pile yarns were included.

Laundering increased the count of the fabrics by a small amount, increased their thickness from 13 to 24 per cent, and decreased their weight from 3 to 13 per cent (except in the case of one fabric which increased 3 per cent). This loss in total weight was due to the loss of finishing materials and of fibers from the tufts. Shrinkage was great enough to be objectionable in only a few fabrics. The increase in the calculated number of tufts per square inch in the laundered fabrics resulted from the increase in count due to shrinkage.

Some fabrics gained in breaking strength when washed but the majority lost from 1 to 27 per cent. The changes in strength of the washed fabrics after abrasion were rather small. Only laundered fabrics were abraded since the new fabrics contained enough finishing material to withstand abrasion for an extremely long time. The change in warp strength after abrading in a filling-wise direction ranged from an increase of approximately 8 per cent to a decrease of 5 per cent, with all but two values lying between —5 and +1 per cent. The change in filling strength after abrading in a warpwise direction ranged from an increase of approximately 8 per cent to a decrease of 11 per cent. Here three-fourths of the fabrics changed in strength from between —5 and +1 per cent. Obviously, the ground yarns received little damage from the abrasion.

The lightweight fabrics (Nos. 1 and 2) lost between 15 and 20 per cent in thickness when rubbed in a filling-wise direction. All other fabrics lost between 7 and 12 per cent. When abraded warpwise, nine fabrics lost between 4 and 13 per cent in thickness, and the other three including fabrics 5, 10, and 4 lost 23, 28, and 52 per cent respectively. These three fabrics lost practically all the pile yarns in the abraded area.

Changes in both breaking strength and thickness indicated that most of the fabrics stood up fairly well under abrasion. It was interesting to compare the visual rating of the worn area of these fabrics with the results of physical tests. Fabrics 4 and 10 were rated as poor because practically all the pile yarns were worn off the warpwise abraded samples. Fabrics 1, 2, and 6 were only fair for both directions of abrasion. All other fabrics were rated as good for one and sometimes for both directions of abrasion since there was no appreciable wear. A high correlation existed between the change in thickness and the visual rating of the abraded area.

The tests of colorfastness to light indicated that only two fabrics (Nos. 1 and 3) would become undesirable in color after long exposure to light. All fabrics were rated by standard dyeings and these two changed equivalent to standard dyeing L1 after 80 hours' exposure. Even after the first 20 hours exposure they gave a noticeable change in color equivalent to standard L3. Fabrics 2 and 11 showed no change in color after 80 hours' exposure, while fabric 5 had only a slight change after 20 hours with no further fading after other exposures. All other fabrics showed progressive fading as the number of hours increased and were equivalent to standard L3 or L5 at the end of 80 hours' exposure.

Colorfastness to laundering indicated that most of these corduroy fabrics could be washed satisfactorily so long as no bleaching agent was used. None of the fabrics faded when washed with neutral soap. Five did not fade at all when washed with soda-soap solution, two faded badly, but the others only changed to slightly lighter shades. Most of the fabrics faded when washed with the aid of a bleaching agent. These corduroys could not be washed with other fabrics except when a mild soap was used. Even then some of them would bleed and stain cottons, silks, or rayons washed at the same time.

Large pieces of each fabric were washed and then brushed, steamed, or ironed to determine the best method for smoothing such fabrics. These corduroys looked best after laundering when merely brushed along the direction of the rib while still slightly damp.

STATISTICAL ANALYSIS

In order to obtain additional information concerning variations in the count, breaking strength (strip method), and weight of the new fabric, analyses of variance were made as given in Table 4. The fabrics were divided into three groups because of obvious differences in physical properties and preliminary comparisons of data. Group 1 consisted of the lightweight fabrics, group 2 of medium-weight fabrics with v-pile yarns, and group 3 of medium-weight fabrics with w-pile yarns.

Large differences were found between fabrics in each of the three groups. In five of the fifteen analyses of variance in Table 4, differences between locations within the fabric were greater than would be expected in one of 20 tests from random samples of homogeneous material. However, each of these five significant variations may be attributed to one or at most two fabrics. The relative magnitude of the variances for location and fabrics was such that the same comparisons between fabrics would be obtained if duplicate sets of determinations were not used.

A comparison of the variability within the individual fabrics was made by the chi-square test[3] of homogeneity of the separate terms making up the error mean squares in Table 4. Error terms were homogeneous for all properties in the analysis involving fabrics 1 and 2 and for all except warp count of numbers 3 and 4. None of the

(Continued on page 315)

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Outing, Philadelphia Section, Whitemarsh Valley Country Club, June 20, 1941.

Outing, Rhode Island Section, Norwich Inn, Norwich, Conn., June 20, 1941.

Outing, Piedmont Section, Ocean Forest Hotel, Myrtle Beach, S. C., June 27 and 28.

Annual Meeting and Convention, Carolina Hotel, Pinehurst, N. C., Oct. 31, Nov. 1, 1941.

VAT DYES ON MIXED FIBERS*

ORMOND W. CLARK**

THE bulk of the fabrics containing spun rayon mixed with cotton, linen, acetate or wool fibers have been dyed with direct or diazotized and developed dyes on the cellulose fiber and with such special acetate or wool dyes as might be required on those fibers. In many cases, the very cheapest direct dyes of very inferior fastness have been used on the cellulose fiber. The fastness of the colors which have been dyed with direct or with diazotized and developed dyes has not received unequivocal consumer approval.

The consumer, wearing garments of spun rayon mixtures outdoors, where the strong fading action of prolonged and intense sun exposure and the heavy soiling acquired during active participation in sports place severe demands upon the fastness properties of the dyes, cannot receive completely satisfactory service from his otherwise very attractive and comfortable apparel unless the colors have been produced with dyes of the all around fastness of the vat dyes. However, up to now, neither the demand for, nor the supply of, vat dyed spun rayon mixtures has represented a major portion of the total yardage. There are several reasons for this:

First: The dye manufacturer, the converter, and the retail merchant have not been completely successful in educating the ultimate consumer in the very superior fastness qualities of vat dyes, which greatly outweigh their slightly greater cost, and which the consumer would demand, were he assured that he would receive the advantages for which he was willing to pay. If the consumer does happen to know the difference between really fast and fugitive colors, and attempts to purchase garments with fast colors, he is often unable to get from even the largest and most pretentious retail establishments, any definite commitment as to the type of dye or the fastness of the shade, and the price of the garment is no criterion either. And the confused consumer's evaluation of fastness is twice confounded by those ultra-clever advertisements which proclaim that merchandise is dyed with fast colors, the word fast being accompanied by a microscopic asterisk directing the patient and unusually persistent reader to an inconspicuous statement which cautions the purchaser to wash the colors separately and with great celerity in C.P. soap and lukewarm water, and wisely says nothing about light fastness.

Second: The general converting trade, with a few notable exceptions, in their efforts to produce tremendous quantities of merchandise which can be sold to the mass consumer, vociferously object to paying the slightly increased cost per yard demanded by the use of dyes of the highest quality, although it might only increase the cost of a finished garment by from 10 to 50 cents, and the average increase would be nearer the former figure. They claim the consumer would refuse to pay a slightly higher price for a better product.

It is worth noting, however, that certain retail concerns, whose continued success in business depends on repeat orders, do sell vat dyed spun rayon and cotton slack suits for less than 3 dollars. Other concerns, which perhaps feel that their potential consuming public is so vast that they need to sell each consumer only once, charge 10 dollars or more for apparel which is dyed with colors of such inferior fastness that a couple of rounds on a golf course render it unfit for further public display.

Third: The application of vat dyes on mixed fiber fabrics requires scientific knowledge of dyestuff properties, technical skill in their application, a modern well equipped dyehouse, and laboratory control, and, therefore, was first undertaken only by those very large and progressive plants with adequate experimental facilities and scientifically trained personnel. They have successfully dyed a moderate yardage of mixed fiber fabrics with vat dyes and other suitable dyes of comparable fastness.

A consistent although gradual growth in the use of vat dyes on mixed fiber fabrics has been under way for several years, and unless the world war situation interferes, should progress at an accelerated pace, particularly if assisted by constructive advertising and merchandising policies. Therefore, it may be interesting, particularly to those plants which have not yet developed an adequate experimental knowledge of the behavior of vat dyes on mixed fibers, to outline some of the more important factors to be considered in the application of vat dyes.

An exhaustive and comprehensive exposition of the use of vat dyes on mixed fibers, which would outline the behavior and properties of all the important vat dyes, and which would give detailed and definite recommendations for their practical application, cannot be given in a brief summary such as this. However, it is possible to select a few of the various classes of widely used vat dyes, discuss some of their important characteristics, indicate some of the practical methods by which they may be applied, and

*Presented before New York Section, January 24, 1941; Rhode Island Section, February 28, 1941; Northern New England Section, March 4, 1941.

**Calco Chemical Division, American Cyanamid Co.

show some of the effects obtainable on various fabrics.

The practical dyeing of fast colors on all spun rayon fabrics, spun rayon and cotton, and spun rayon and linen fabrics has been discussed in Calco Technical Service Bulletin No. 570, which was distributed some months ago, and since these methods follow standard vat dyeing procedure, I shall not repeat them, but I shall be glad to answer any questions about them.

The dyeing of vat colors on spun rayon and wool and on spun rayon and acetate fabrics requires special attention in order that the wool or acetate fibers shall not be seriously damaged and in order that the desired color effects and fastness properties may be obtained. By the judicious selection of dyes and with careful control of alkalinity and temperature, such fabrics are being dyed in regular production by continuous machine reduced-vat methods and by pad-pigment jig methods.

A study of the behavior of vat dyes in the caustic soda vat in comparison with their behavior in other alkaline reducing media is necessary in order that methods may be devised for dyeing vat colors on fabrics containing wool or acetate which will secure proper fixation of the dye with a minimum deteriorating effect upon the wool or acetate.

In Table I are shown the breaking strengths of all wool fabrics which have been treated for 30 min. under the described conditions, in several different alkaline reducing liquors which might be used in vat dyeing. It should be noted, however, that breaking strength alone is not a complete criterion of the damage which may have occurred to the wool, as chemical attack on the disulfide linkage, loss of elasticity and harshening of the fiber, or even partial solution of the wool may occur before loss of strength is serious. In mixtures of spun rayon and wool, somewhat more damage to the wool is probably commercially permissible than is the case in an all wool fabric. The pH exhibited by several alkaline reducing liquors is shown in Table II.

TABLE I

Effect of Vat Dyebaths on the Breaking Strength of a Wool Fabric

	pH	*Breaking Strength*
Original fabric	—	100%
After 30 min. in 1½ oz. $Na_3Po_4.H_2O$ / ½ oz. hydro per gallon at 140° F.	11.5	94%
After 30 min. in 3 oz. $Na_3Po_4.H_2O$ / 1 oz. hydro per gallon at 140° F.	11.5	90%
After 30 min. in ½ oz. NaOH / ½ oz. hydro per gallon at 120° F.	11.8	76%
After 30 min. in 1 oz. NaOH / 1 oz. hydro per gallon at 120° F.	11.8	68%

A simple test indicative of the effect of alkaline treatment on wool may be made by immersing the fabric for 5 minutes in a cold 0.02% solution of Calcocid Fast Blue BL. Untreated wool absorbs very little dye, wool treated in trisodium phosphate absorbs a small amount of dye, and wool treated in caustic soda absorbs considerable dye. Microscopical examination of the fiber and manual examination of the fabric assist in evaluating damage to the wool.

Illustrative of the behavior of some representative vat dyes when reduced with trisodium phosphate and hydro in comparison with their behavior when reduced with caustic soda and hydro, are the following curves, which, in a strict sense, are only applicable to the specific conditions under which they were determined. (See Fig. I.)

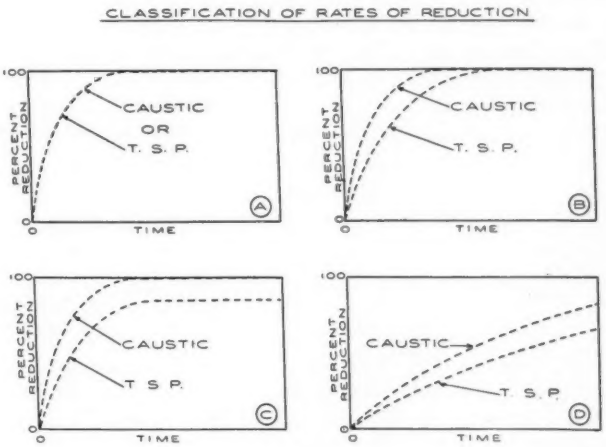

Fig. 1

With trisodium phosphate reduction, the vat dyes may be classified as follows:

1. The leuco compound may be chemically the same as with caustic soda reduction, and the conversion to leuco may be complete, i.e., Calcoloid Navy Blue NTD.

2. The leuco compound may be chemically the same as with caustic soda reduction, but the conversion to leuco may be incomplete, i.e., Calcoloid Violet 2RD.

TABLE II

NaOH ¼ oz./gal.	NaOH ½ oz./gal.	NaOH 1 oz./gal.
Hydro ½ oz./gal.	Hydro 1 oz./gal.	Hydro 1 oz./gal.
pH 11.8	pH 11.8	pH 11.8
$Na_3PO_4.H_2O$ 1 oz./gal.	$Na_3PO_4.H_2O$ 2¼ oz./gal.	$Na_3PO_4.H_2O$ 4¼ oz./gal.
Hydro 1 oz./gal.	Hydro 1 oz./gal.	Hydro 1 oz./gal.
pH 11.5	pH 11.5	pH 11.5
Na_2CO_3 1 oz./gal.	Na_2CO_3 1½ oz./gal.	Na_2CO_3 2 oz./gal.
Hydro 1 oz./gal.	Hydro 1 oz./gal.	Hydro 1 oz./gal.
pH 10.7	pH 10.9	pH 10.7

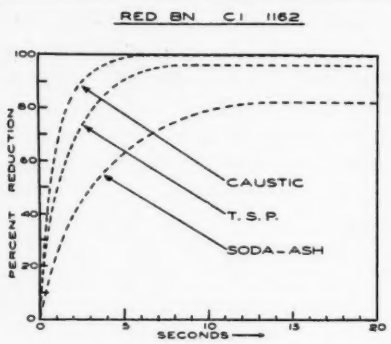

Fig. 2

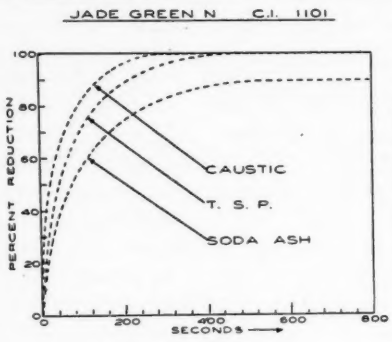

Fig. 3

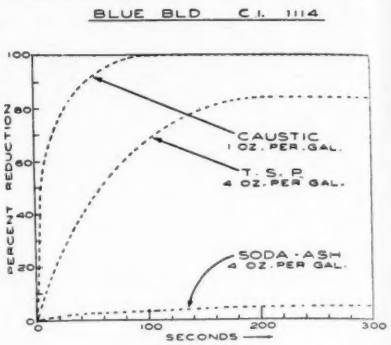

Fig. 4

3. The leuco compound may be chemically different with trisodium phosphate reduction than with caustic soda reduction, i.e., Calcosol Brown R.

The vat dyes may also be classified as follows:

A. With trisodium phosphate reduction the rate of formation of the leuco may be the same, or substantially the same as the rate of formation with caustic soda reduction and the percentage conversion to leuco may be the same, i.e., Calcosol Red Violet RRK conforms most nearly to this type.

B. With trisodium phosphate reduction, the rate of formation of the leuco may be slower than with caustic soda reduction, but the percentage conversion to leuco may be the same, i.e., Calcosol Jade Green N.

C. With trisodium phosphate reduction, the rate of formation of the leuco may be slower than with caustic soda reduction, and the percentage conversion to leuco may not be the same, i.e., Calcoloid Dark Blue BOD.

D. Under the conditions of these experiments, in which the temperature of reduction did not exceed 120° F., the conversion to leuco may be incomplete in the maximum time allowed, 60 minutes, even with the caustic soda reduction, i.e., Calcoloid Violet 6RD.

The curves above illustrate the behavior of several dyes when reduced with caustic soda, with trisodium phosphate, and with soda ash.

Figure 2 shows that Red BN reduces at nearly the same rate with trisodium phosphate as with caustic soda and gives nearly the same percentage conversion to leuco. With soda ash the rate is slower and the percentage conversion to leuco is smaller, but the differences are not so great that Red BN should definitely be considered only for caustic soda or trisodium phosphate reduction.

Figure 3 shows that Jade Green takes nearly twice as long to reduce with trisodium phosphate as with caustic soda but that the percentage conversion to leuco is similar in each case. With soda ash the rate of reduction is slower and the percentage conversion to leuco is smaller.

Figure 4 shows that the rate of reduction of Blue BLD with trisodium phosphate is slower than with caustic soda, and the percentage conversion to leuco is lower. The rate of reduction with soda ash is very slow and the dye is not suited for reduction in a soda ash vat.

In Figures 2 and 3 the amounts of alkali in each case were 1 oz. per gallon. In Figure 4 the amount of trisodium phosphate and of soda ash was increased to 4 oz. per gallon to see if a dyestuff of this type would behave like those shown in Figures 2 and 3 if an extra large amount of alkali was used.

Table III gives data illustrating the behavior of several vat dyes when reduced with caustic soda and when reduced with trisodium phosphate. If the reduction reached equilibrium during the experiment using caustic soda, the equilibrium per cent was taken as 100. The equilibrium per cent during the experiment using trisodium phosphate is stated as per cent of the equilibrium reached with caustic soda.

TABLE III

Classification	*Name*	*C.I.*	*Time Sec. Caustic*	*Equil. %*	*Time Sec. T.S.P.*	*Equil. %*
2C	Black BBD	1102	90	100	180	89
2C	Blue BOD	1099	120	100	240	38
1B	Navy NTD	1100	60	100	100	100
1B	Jade Green N....	1101	300	100	540	100
2C	Orange GD	1096	720	100	1740	90
2C	Orange 4RD	1098	180	100	300	72
2C	Violet RRD	1104	540	100	1200	92
2C	Orange RRTD ...	1097	540	100	1440	82
2C	Red BN	1162	6	100	8	96
1B	Violet BN	1163	15	100	17	100
1B	Red Violet RRK..	1161	5	100	7	100
3C	Olive R	1150	50	100	65	92
3C	Brown R	1151	50	100	65	92
2C	Yellow G	1118	16	100	25	92
2C	Brill. Violet RK.	1135	900	100	900	92
2C	Blue GCD	1113	900	100	900	70
2C	Blue BLD	1114	100	100	200	83
3D	Orange RD	1217	3600	83	3600	38
3D	Violet 6RD	1212	3600	60	3600	14
2C	Blue 2B	1184	360	100	360	82
2C	Yellow GCD	Pr. 9	540	100	1200	96
2C	Grey BD		180	100	60	70
3C	Ind. Khaki 2G..	Pr. 122	300	100	540	28
2C	Grey D		120	100	300	65
2C	Grey RD		100	100	420	73

KODACHROME SLIDES

. . . At this point a number of Kodachrome slides were shown . . .

The Kodachrome slides show the behavior of various fibers when dyed by the selected procedures. The types of vat dyes commercially available are so many, and the

possible variations in methods of application are so great in number, that it is not possible to do more than indicate a few of the results which can be obtained, and these few slides and the brief discussion which has preceded them serve only to show that there are interesting possibilities in the use of vat dyes in mixed fiber fabrics.

The preceding discussion has touched on some of the underlying theory in the application of vat dyes to mixed fibers and the Kodachrome slides show methods of securing various color effects such as

1. White acetate effects.
2. White wool effects.
3. Solid shades on mixed fibers.

1. 18 slides showing Pigment Padded Shades reduced in two different media; a caustic soda bath and a trisodium phosphate bath. To show the dyeing behavior of various fibers, two fabrics are shown; one is a wool fabric with effect threads of wool, cotton, silk, viscose, and acetate; and the other is a bleached cotton print cloth. Adjacent wash tests show how well the dye is fixed in each case.

2. 31 slides showing Pigment Padded Shades reduced in a trisodium phosphate bath. The fabric has a cotton warp and wool filling; with effect threads of wool, cotton, silk, viscose and acetate. A trisodium phosphate bath leaves the acetate comparatively clean, depending partly upon the specific dye, and leaves the wool in much better physical condition than is the case when caustic soda is used.

3. 5 slides showing dark and light Pigment Padded Shades reduced in a trisodium phosphate bath.

4. 23 slides showing a twill fabric woven from yarns containing 60 per cent of spun rayon and 40 per cent of wool. The fabric was padded through Deceresol OT and dried and then Pigment Padded with the vat dyestuff dispersion. The padded fabric was then reduced in various types of alkaline media and the dyeing behavior and color fixation is shown by the dyed fabrics and the adjacent wash tests.

5. 10 slides showing a cotton warp, wool filling fabric with effect threads of wool, cotton, silk, viscose, and acetate which has padded through a caustic soda reduced vat dyebath. Each slide shows the effect of three methods of operation:

6. The fabric has been padded through Deceresol OT and dried before being padded with dye.

7. The fabric has been padded without previous treatment.

8. The fabric has been padded without previous treatment, but the reduced vat dyebath contained ½ oz. of glue per gallon.

9. 4 slides showing 5-effect thread fabrics and a fancy rayon and acetate patterned fabric which have been padded through a reduced vat dyebath containing caustic soda. Two dyeings have been made; one without glue in the dyebath, and one with glue in the dyebath. Adjacent wash tests show how well the dye has been fixed.

10. 3 slides showing 5 effect thread fabrics which have been padded through a bath reduced with trisodium phosphate instead of caustic soda.

The main thing the slides do show is the wide variety of effects you get according to what alkali you use and what method of preparation of the goods you use, and what method of dyeing you use. It shows that quite a wide variety of effects can be obtained, and we can't really predict them. We have got to try to find out.

These are a few fabrics which have been dyed in practice. These are all spun rayon fabrics. These are spun rayon and linen mixtures. That was not an easy fabric to dye because they had the linen in the raw state, which, if you have seen it, you know is dirtier looking than burlap. It is rather a brown shade. It was mixed with the rayon, which is very clean, very absorptive, and to get a solid dyeing required quite a bit of manipulation.

These samples represent spun rayon and cotton mixtures. And these represent spun rayon and acetate mixtures.

The writer wishes to acknowledge the assistance received from members of the Calco and American Cyanamid staffs, Dr. Kienle, Dr. Royer and Dr. Stiegler, and Messrs. Benbrook, Woodbury, and Moran during the investigation which preceded the preparation of this paper.

DISCUSSION

New York Section Meeting

Mr. Mannheimer: You have a difference in your number for your equilibrium from phosphate and caustic. After the dyeing, did that only show in the deepest of shades, or did it also show in differences of the shades?

Mr. Clark: It shows in differences of the shade, too. For instance, take a Blue BCD. With a correct reduction, and then the final dyeing and development of the shade, you get your true red shade. In the case of an inadequate reduction, one may say under improper conditions with the trisodium phosphate, the shade comes up somewhat greener and duller, although on a wash test there doesn't seem to be much difference, at least in a lighter or medium dyeing. It means you may not have the same end point product in your equilibrium.

Mr. Mannheimer: Is that difference in the strength of the shade constant, or does it vary with the increase of dyestuff? For instance, if you have a light shade, is the percentage of difference just as big as in a deep shade?

Mr. Clark: That depends somewhat on the conditions. If your reducing medium is quite inadequate, you would probably see much more difference in a dark shade than in a light shade.

Mr. Kennedy: On spun rayon material that has to be dyed in an overhead reel machine, would you rather pigment dye it or pre-reduce it?

Mr. Clark: That would again depend partly on the depth of the shade. Of course, you could pre-reduce only the light and medium shades, and in that case I would rather pre-reduce so as to get some partial fixation of color before adding it to the reel machine. Otherwise, you might get lay marks or streaks; whereas, if you say "padded reduced," you can get positive fixation of your color so that when you put it in the reel machine and obtain your dyeing and complete fixation of color, you have no mobility of color.

Mr. Kennedy: How about making an addition on the box?

Mr. Clark: The dyeing of vat colors on reel machines is a rather tricky proposition, particularly on the general run of reel machines. If you can build your reel machine especially for your job, that helps some. But to take the ordinary reel machine that is used for direct colors, your reel is rather far from the surface. You get a lot of splashing. The pin rail sticks are close together, which tends to make the goods run in a dense ropy form, and while vat colors have been dyed on the reel machine successfully, it is a very delicate proposition. It is nothing you can hand over to the general grade of mill labor without very, very careful supervision.

I think there was one plant that did quite a bit of rayon on the reel machine several years ago, using a considerable amount of auxiliary agents in the dyebath, but it took so much of those auxiliary agents that they didn't make out economically.

Chairman Meili: The samples you showed tonight were all pad-jig dyed?

Mr. Clark: Except that the first four were pad reduced. With regard to those, you can run into a booster box and use a trisodium phosphate booster with possibly some auxiliary agents in there such as glue, or sulfite cellulose.

Chairman Meili: I have been asked by skein dyers whether they could dye vats on rayon skeins in a Smith Drum machine?

Mr. Clark: Yes, that can be done, but you have to get your shade off in about ten minutes, and five is better, because your hydro consumption is so high. But I have seen it done, and I know plants that are doing it. The color exhausts very quickly.

Mr. Gonnerman: How is the penetration on the yarns when you dye so quickly?

Mr. Clark: That depends somewhat on the selection of dyestuffs. There was a very good article that appeared in October, 1939, in the *Journal of the Society of Dyers and Colourists,* on the behavior of vat dyes on rayon. If anyone hasn't seen that article, I would recommend it very highly. That brought out very clearly some of the factors in the dyeing of rayon. The two points which they made particularly were that the dyes should be selected not only from the viewpoint of their exhaustion rate, but also from the viewpoint of their diffusion rate within the fiber.

There are some dyes that will jump right on the surface of the fiber and stay there without much diffusion within in any practical amount of time that you could run them. Other dyes will jump on the surface, but then they will diffuse and give you a solid dyeing. The particular article I refer to rated quite a list of dyed, both by exhaustion rate and by diffusion rate.

Mr. Behr: What is the amount of trisodium phosphate required to replace the alkali of the caustic soda?

Mr. Clark: About the minimum amount you could use, is an ounce of trisodium to the gallon, and half an ounce of hydro, and I think you would be safer with probably two ounces of trisodium.

Mr. Behr: Isn't that rather prohibitive in cost?

Mr. Clark: I think not. As in padded pigment work, your liquor is fairly short and trisodium is not too expensive a chemical, so that you can use it.

Mr. Mannheimer: On those jig pre-reduced dyeings, what sort of a jig was used? Were the cylinders under the liquid or on top of it?

Mr. Clark: Those were regular jigs. Naturally, in handling this type of fabric, you want jigs that run with as little friction as possible, where you have very delicate control over your braking, where your clutch is in good shape, and so on. Some of these newer, so-called tensionless jigs, are very good, but I have done quite a bit of it on just ordinary jigs, which are in good shape, of course, and with capable operators.

Mr. Mannheimer: What I have in mind is whether or not the cylinders should be submerged.

Mr. Clark: No, they were regular jigs in good mechanical shape, such as you dye direct colors on.

This particular fabric is best dyed on the Duo Dyeing machine, which is sort of a combination of jig and padder. You may have seen that. This is a mesh fabric. If you dye that in an ordinary jig it carries so much air into your dyebath that it is very difficult to produce a level dyeing, and keep your bath well reduced. It is better dyed on this Duo Dyeing machine on which your beam and your roll are nearly all submerged in the liquor, and you have a squeeze roll between the two parts of the jig.

They are using those in the South for such fabrics as hopsacking, those coarse, mesh fabrics which give you all sorts of trouble on an ordinary jig. It helps in producing level dyeing, in keeping your hydro consumption down, and on the selvages.

Mr. Kennedy: On the bulk dyeing of vat colors do you recommend the hydro or the phosphate method?

Mr. Clark: I haven't done any of it on a reel machine, so probably there is no sense of my hazarding a guess to that extent.

Mr. Kennedy: It has possibilities?

Mr. Clark: Yes, it has possibilities. With the proper selection of dyes, it probably has good possibilities.

FIRE RETARDANT TREATMENTS
for Textiles*

DR. W. E. GORDON**

THE flameproofing of textiles is generally considered as a rather modern development, but it is interesting to note that one Nikolas Sabbattini recommended that clay or gypsum be mixed with the color used in painting theaters and scenery as a means of fire prevention in 1638. The first patent in this field was issued in 1735 to Jonathan Wild of England covering a flameproofing mixture of alum, ferrous sulfate and borax. The noted chemist, Cay-Lussac, published in 1821 the results of an investigation showing the value of such chemicals as ammonium phosphate, ammonium chloride and borax for flameproofing purposes. Since that time a great many other chemicals have been recommended including ammonium sulfate, sodium sulfate, sodium tungstate, stannic oxide, borax-boric acid mixtures, ammonium sulfamate and a very large number of organic compounds. A rather exhaustive bibliography of references on this subject has been compiled by Akin, Spencer and Macormac and published in the AMERICAN DYESTUFF REPORTER last year.†

During the past two or three years there has been a very rapid growth in both the need and demand for an effective flameproofing treatment for textiles. More frequently we now find newspaper stories dealing with injury or death resulting from the accidental exposure to flame of a workman's overalls, a woman's negligee or a child's dress. We also hear of many cases in which large property losses have been suffered through the accidental ignition of curtains, drapes or other decorations in night clubs, theatres, hotels, and other places of public assembly.

Many of you are no doubt familiar with one or more accidents of this kind—for example, just last year the flame from a careless cigarette or match ignited the decorations in a very crowded dance hall, resulting in death and injury to a large number of people. Similar tragedies have occurred in many other places of public assembly, all of which have emphasized the necessity for establishing flameproofing regulations. While no reliable figures are available on the number of persons or the value of property harmed in this way, it is a foregone conclusion that the more widespread use of a reliable flameproofing treatment on various textile materials would greatly reduce the injuries and losses involved. Several of the larger cities, including New York, have passed ordinances which require the periodic flameproofing and inspection of all drapes, decorations, etc., in such places as hotels, theatres, night clubs and restaurants. Even department stores and other retail establishments are subject to control in certain instances.

While regulations of the above kind will no doubt be very useful in diminishing the fire hazards in various public places, they will have little effect on the mass of private individuals who will no doubt continue to smoke cigarettes in bed, or lean over the gas stove wearing a fuzzy bathrobe or permit their children to play with matches. Unfortunately, accidents of this kind will continue to happen, but here again the number and severity of injuries may be reduced through the intelligent use of a fire retardant treatment.

Those of you who are associated with either textile manufacturing or merchandising may already have noted that the consuming public is beginning to show a real interest in a fire retardant treatment for textiles. This consumer interest, in turn, can be traced to the expanding use of napped or pile fabrics, particularly in the garment industry since fabrics of this kind represent a greater fire hazard than those with a smooth, hard finish.

Now that we have pointed out the need for this kind of treatment, let us look into a definition of the term, "fire retardant," and examine the characteristics of the various products which are available for the purpose.

A fire retardant may be defined as a substance which renders an inflammable material incapable of supporting combustion. By this it is not meant that fire retardants will confer "fireproof" characteristics to treated materials, but they will serve to prevent the spread of flame, thereby greatly reducing fire hazards. To illustrate, I shall hold a match to this piece of cotton fabric, one-half of which has been flameproofed and the other half left untreated. You will observe that the untreated portion is rapidly consumed by the flame, whereas the flameproofed portion has merely charred where it has come in contact with the flame and has contributed nothing to the general blaze.

The action of most fire retardant chemicals is to prevent adequate contact of textiles with air when exposed to flame. Consequently, most fire retardant chemicals can be classified as (1) those which actually coat fibers with a film of non-combustible material or which produce such a film under burning conditions, and (2) those which evolve non-combustible gases or liquids under burning conditions, so as to exclude air or oxygen. We might also classify these compounds as organic or inor-

*Presented at meeting, New York Section, March 28th, 1941.
**E. I. du Pont de Nemours & Co., Inc.
†Am. Dyest. Reporter, *29*, P418, P445, 1940.

ganic compounds. Organic chemicals are attractive since they are for the most part insoluble in water and consequently would lend themselves to a more permanent type of treatment. However, organic compounds of a non-inflammable nature are rather few in number, and even those which have fire retardant characteristics are comparatively low in efficiency, thereby requiring a comparatively high retention of chemical in the fabric. Furthermore, it is usually necessary to employ an organic solvent of inflammable nature in order to incorporate these chemicals into fabrics and this operation is disadvantageous from the mill standpoint. Treatments of this kind usually have a very marked effect upon the appearance, feel and other general characteristics of textiles, all of which factors have served to confine the use to certain special applications.

Inorganic chemicals are free from many of the disadvantages mentioned above and the balance of this paper will be confined to this class of compounds. Inorganic fire retardant chemicals are for the most part water soluble and are applied to textiles in the form of a water solution. None of them exerts any substantive action to textile fibers, consequently most of them are easily removed from treated fabrics by laundering or by exposure to conditions of water leaching. There are some exceptions to this latter statement, notably the so-called "stannate" treatment which involves treating fabrics in a two-bath process with sodium stannate and an ammonium salt such as ammonium sulfate. This results in precipitation of stannic oxide on the fibers along with residual ammonium sulfate. While this treatment is said to impart rather permanent flameproofing characteristics to fabrics, field experience indicates that a single laundering will reduce the fire retardant efficiency below that required for satisfactory performance.

A number of samples of cotton fabrics are available here for your examination, each of which has been treated with one of the more common inorganic fire retardant chemicals. While all of these samples are adequately flameproofed, you will observe that there are certain obvious differences in appearance, feel and other general characteristics associated with each treatment. A rather extensive research program in the Du Pont laboratories on various flameproofing chemicals has developed a large amount of data which indicates that ammonium sulfamate, or formulations based on this chemical, possess outstanding advantages over other water soluble inorganic fire retardant chemicals. In particular, your attention is called to the fact that ammonium sulfamate exerts no stiffening action on treated fabrics and is completely free from any tendency to crystallize or effloresce on the surface of such fabrics, even when exposed to conditions which favor this so-called "dusting out." These characteristics are particularly important if it is desirable to apply the treatment to very fine fabrics where the appearance, drape, feel and absence of crystalline deposits are essential.

Numerous other factors enter into the choice of chemical to be used for flameproofing fabrics. For example, it is important that the chemical should have no undue effect upon the strength of the treated material. Strength losses in treated fabrics can usually be associated with the use of rather strongly acidic chemicals or to the formation of such chemicals during drying or upon ageing. Most ammonium salts are slightly acidic in water solutions; consequently for the treatment of fabrics in which even moderate decreases in strength must be avoided, it is desirable to work with treating solutions which are as nearly neutral as possible. Du Pont Fire Retardant "CM" is a composition based on ammonium sulfamate which has been modified by the addition of suitable chemicals to achieve this result without appreciably affecting other fabric characteristics. For example, Fire Retardant "CM" has no effect on the strength of cotton or wool, and imparts only a slight decrease in the strength of rayon or silk fabrics, which are more susceptible to strength losses through the addition of any inorganic chemical.

From the merchandising angle, it is particularly important to know whether a given fire retardant treatment will have any skin irritant action. Tests conducted on 200 individuals by the Haskell Laboratory of Industrial Toxicology showed that Du Pont Fire Retardants are free from skin irritant action.

These advantages of sulfamate-type fire retardants have been confirmed through widespread customer evaluations and the Du Pont Company has constructed a plant for the production of these chemicals on a commercial scale at Grasselli, New Jersey. Operations are scheduled to start about July 1st.

From the manufacturer's viewpoint, it is important to learn something about the ease of application of these chemicals. In general, it may be said that water soluble fire retardants may be applied in the same way and usually with the same type of equipment as that used for the application of numerous other textile finishes. The fundamental steps are (1) immersion of the goods in the treating bath, (2) squeezing through pressure rolls to obtain the desired retention, and (3) drying. The concentration of the treating bath and the pressure on the squeeze rolls should be adjusted so as to permit the proper pick-up and retention of the chemicals in the goods. For most fabrics, it is necessary to incorporate approximately ten per cent by weight of the dry fire retardant chemical into the goods to achieve adequate flameproofing action. It is very important to control this part of the operation since the incorporation of even slightly less than the stipulated quantity of fire retardant will permit the fabric to burn almost as readily as though it were not treated at all. The drying operation should be conducted at moderate temperatures, preferably not over 180 to 200° F. so as to avoid any deleterious action on the finished goods. If the fire retardant chemicals are based

on ammonium salts, it is desirable to avoid the use of equipment consisting of brass, bronze or copper since all ammonium salts have a corrosive action on these metals.

There are a number of factors which contribute to the different degree of inflammability of various fabrics. In our experimental work we have found that the minimum retention of fire retardant needed to impart good flameproofing characterictics varies somewhat with different textile fibers. For example, with one type of fire retardant, pure silk requires an average retention of 10 to 16 per cent, viscose rayon 12 per cent, cotton and linen 10 per cent and wool 6 per cent. Nylon and heavily weighted silks are essentially flameproof without treatment, while acetate type rayon, which burns somewhat slowly, does not readily lend itself to treatment. It should be stressed, however, that these figures do not represent the degree of hazard involved with any particular type of yarn since under normal conditions the use of a fabric of open construction or with a fuzzy pile surface offers a much greater fire hazard than one with a tight construction or with a smooth hard surface. This is easily demonstrated with samples of treated and untreated cotton and rayon fabrics which we will now expose to burning conditions. You will observe that in the case of the cotton and rayon pile fabrics, the burning starts and spreads much more rapidly than with the smooth finished fabrics of cotton and rayon. You will also observe that the fire retardant treatment of these samples has rendered each one incapable of supporting combustion.

The use of pile fabrics has increased very considerably during recent years chiefly through the advent of "brushed knit" rayon goods. This type of fabric is used rather widely in the manufacture of pajamas, housecoats, bathrobes, negligees, smoking jackets, polo coats and a variety of other garments. Because of their fuzzy surface, these fabrics have a greater fiber surface exposed to the air and as a result, they catch fire and spread flame more rapidly than do rayon or cotton fabrics of more orthodox construction. Another factor to be considered in this discussion of pile fabrics is the increased use of newer types of rayon fibers in the manufacture of blankets and carpets. When substituted for wool, the fire hazard is increased since wool in itself is somewhat fire resistant. However, where rayon fiber is substituted for cotton, as in blankets and similar fabrics, there is no increase in the fire hazard.

Several manufacturers of rayon pile fabrics have investigated the flame-proofing process and are now offering treated merchandise. For this purpose, ammonium sulfamate and its derivative, Fire Retardant "CM", have been found particularly advantageous because they exert no stiffening action and are not removed during the napping operation. The fire retardant treatment is applied to the dyed fabrics, which are then dried and subsequently passed over the brushing machines. In many cases it has been found possible to apply these fire retardants in the same treating bath with water repellent and other textile finishes, thereby materially reducing costs.

Many of the fabrics upon which a flameproofing treatment is applied, are normally subjected in use to dry cleaning. The fire retardant chemicals of the inorganic water soluble type are not removed by common dry cleaning solvents. Washing these fabrics in water, dissolves the chemicals and the fire retardant effect is lost. It may be pointed out, however, that several of the leading laundries now offer a flameproofing service to their customers, the procedure being similar to the ordinary starch treatment. It is not improbable that the flameproofing operation may eventually find its way into household use.

From the merchandising viewpoint, it seems desirable, in those cases where the customer is advised of the presence of the flameproofing treatment on a garment, that suitable tags be employed pointing out the characteristics of the treatment including statements regarding the permanency to dry cleaning and laundering.

In conclusion it should be stressed that there are several factors other than actual flameproofing efficiency which merit consideration in the choice of the chemical to be used on any particular textile material, and it is only through careful attention to these secondary factors that optimum results may be obtained.

DISCUSSION

Mr. Beckwith: Have standard methods for testing flameproofing been developed?

Dr. Gordon: Yes. There has been a lot of work done on that. I would say that there are probably fifteen or twenty tests described. Incidentally, those were written up in a comparatively recent issue of the DYESTUFF REPORTER.* One test, by the same workers, Aiken, Spencer and Macormac, describes the apparatus involved for a very simple test. A hoop, 4 inches in diameter, holds the cloth sample. That is put on an inclined surface and one inch beneath that you have a metal cup containing 0.3 milliliter of absolute alcohol. That is ignited and all the alcohol allowed to burn, and it is observed whether or not the sample catches on fire, whether it glows, and how far the flame has spread.

I think that is a fairly satisfactory test to determine the degree of inflammability. It is simple and does the job. As far as I am concerned, the proof of the pudding is to hold a good strong match to the sample for half a minute or so. That tells you whether it is flameproof or not. It doesn't measure it in inches, or degrees, or anything of that kind, but it is a practical test.

President Draves: Dr. Gordon, I heard Dr. Macormac's paper, and I wonder whether you would be satisfied with Dr. Macormac's test as satisfactory for AATCC practice?

Dr. Gordon: I haven't investigated the test itself. I have just read a description of it. If you want a real thorough test, I think the one developed by the National

*Am. Dyest. Reporter *30*, P91, 1941.

Bureau of Standards and used by them, and as adopted here in New York City for testing flameproofed articles, would give a more precise measurement of the actual degrees, inches, etc., and put it on a scientific basis.

Mr. Ober: What is the commercial price of the sulfamate?

Dr. Gordon: Materials are not yet available on a commercial scale, and the price hasn't been established. When they are available, they will be comparable in price to some of the more well known flameproofing chemicals.

Mr. Deutsch: In connection with a crystallization of ammonium sulfamate, would you say that you don't see it under the microscope because the particles are sub-microscopic, or would you say definitely that you get no crystals at all?

Dr. Gordon: All I can say is to go back to its use in Cellophane. It cannot be detected there by x-ray methods which would show up a definite crystal pattern if crystals were present.

President Draves: Have you been able to apply your ammonium sulfamate to a fabric which has been waterproofed with Zelan, and do you reduce the splash test value after the treatment?

Dr. Gordon: My understanding of it is that these fire retardants, such as ammonium sulfamate, can be applied to a Zelan treated fabric under proper conditions. For example, the Zelan treated fabric will not pick up water or any water solution. If you apply the fire retardant before the Zelan treatment has been dried on the goods, it will take it up and will render the fabric completely flameproof, but the presence of these water soluble salts does lower the water repellency of the Zelan treatment, and that treatment—at least in the fashion I have described—does not bring it up to the Zelan standard.

Mr. Mannheimer: Does sulfamate have any effect on the fastness properties of dyestuffs?

Dr. Gordon: We have conducted a great many tests on quite a variety of dyestuffs, and without going into the details, the general answer to that is that the fire retardant solution has no more effect on the color of goods treated with representative dyestuffs than does ordinary water. In some cases, the presence of salts in the solution actually fixed the color better. There are some fabrics, dyed with certain colors, that are not fast to water, and naturally, when you put them in a water solution of fire retardant, the color is going to come out. In some cases the color may be changed slightly, but that is the exception rather than the rule.

Mr. Mannheimer: I meant particularly in respect to reducing the washing fastness.

Dr. Gordon: The fastness of the color is not affected at all by the fire retardant treatment. Of course, washing the goods removes the fire retardant.

MEETING, PIEDMONT SECTION

APPROXIMATELY 200 members attended the meeting of the Piedmont section which was held at the George Vanderbilt Hotel, Asheville, N. C., April 19, 1941.

Preceding the technical session, members enjoyed a blind bogey golf tournament, prizes for this being awarded at the banquet session by Edgar Ford who was in charge of arrangements for the meeting.

"Rayon, a New Frontier of Progress," a sound film, was presented through courtesy of the American Viscose Corporation. Following this, hosiery members held a round table discussion, and also heard a paper "Crepe de Chine Hosiery" given by B. L. Hathorne of Crepe de Chine, Inc. Rufus Smith and Henry Dixon had charge of this phase of the meeting.

Members interested in mill finishing problems heard a paper "Why Resin Finishes are Growing in Importance" by Alden D. Nute of the Calco Chemical Division of American Cyanamid Co. Discussion followed.

A varied program of entertainment was enjoyed at the regular banquet session. Major Stuart W. Cramer, Jr., President of Cramerton Mills, Inc. was the speaker of the evening, delivering a talk dealing with problems of national defense.

Respectfully submitted,

D. STEWART QUERN, *Secretary*.

INSPECTORS WANTED

THE United States Civil Service Commission reports a shortage of inspectors for the Material Division, Air Corps, War Department, at salaries ranging from $1,620 to $2,600 a year, among which are classified inspectors of textiles having experience with fabrics similar to airfoil covering, parachute materials and tow targets. For the junior grade the entrance requirement is two years of practical experience or four years of technical education. Further information can be obtained from announcement No. 6-249, Revised, available at any U. S. Civil Service office, or postoffice of first or second class.

MEETING, SOUTHEASTERN SECTION

THE Southeastern Section held its first meeting of 1941 on Saturday evening, May 3rd, at the Ralston Hotel in Columbus, Ga. Perrin N. Collier, Vice-President and Director of Research, Callaway Mills, LaGrange, Ga., presided as chairman.

There was a registered attendance of 117; there being 80 members present and 37 visitors.

Paul A. Logue of Monsanto Chemical Company presented a technical paper on Phosphates and Their Uses in the Textile Industry, similar to the discussion presented by him at the annual meeting of the National Association in New York.

Hugh M. Comer, Executive Vice-President of Avondale Mills, Sylacauga, Ala., presented an interesting and

entertaining account of his travels during a recent seven weeks' tour of South America, particularly describing textile manufacturing conditions as he found them in the Latin-American countries.

At a meeting of the officers of the section preceding the general session, George E. Missbach of F. H. Ross & Company, Atlanta, was designated to act as the section's representative on the committee of judges in the annual intersectional paper contest at the annual meeting of the National Association in Pinehurst next Fall. George L. Dozier of Sandoz Chemical Works, Inc., was named as alternate representative. The officers and committee discussed further plans for the presentation of the section's paper in that contest.

It was announced that the next meeting of the Southeastern Section will be held in Macon, Georgia on Saturday, September 6.

Respectfully submitted, OTTO MUELLER, *Secretary.*

TECHNICAL PROGRAM, ANNUAL MEETING

KENNETH H. BARNARD, chairman of the technical program committee for the annual meeting to be held in Pinehurst, N. C., has announced that the same rules for the intersectional contest will be used this year as were adopted last year. In accordance with these rules, and on a basis of 100 per cent, the judges will allow the following consideration to each of three factors, 50 per cent for general scientific value, 30 per cent for originality or record of discovery and 20 per cent for presentation. With one or two exceptions, all of the sections have now selected their judges.

Mr. Barnard has also announced that a Technical Session on Hosiery will be conducted on Saturday morning and T. R. Smith, vice-president of the association, will act as chairman.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

Personal Histories and Employment Records of the following applicants are on file at the office of the American Dyestuff Reporter. Prospective employers may examine them without obligation.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-1

Education—Graduate textile chemistry and dyeing course, Lowell Textile Institute, 1932. Special course in colloid chemistry at M.I.T.

Experience—Library work in spare time while attending school; five years as assistant chemist with knitting mill, duties consisting of testing and grading silk, testing of oils, soaps, dyes, finishes and other chemicals, making up specifications for various lines of hosiery and checking finished product, keeping a check on production costs, control of waste and irregulars, checking competing products and carrying on research to improve product and reduce costs. Woman; age 30; references.

A-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Textile chemist, cotton and rayon thread; agricultural chemist, protein, fat and mineral analysis; special Federal inspector on textiles, New York City; U. S. inspector, war department; chemist-spotter, dry cleaning experience. Age 32; married.

A-B-8

Education—Graduate Chemist.

Experience—Print superintendent, colorist; eleven years' experience in all types of fabrics, specializing on rayon; 8 years' dyestuff laboratory and demonstrating. Excellent references; age 37; married.

A-B-9

Education—Textile School Graduate.

Experience—Executive and sales type of textile chemist and colorist desires position in sales, contact, promotional or supervisory work. Factory, laboratory, office and purchasing experience. Good correspondent. Good personality. Accustomed to assuming responsibility and exercising initiative. 21 years' experience in the textile, chemical and dye industries. Opportunity most important. Age 43; American; married.

A-B-10

Education—1 year of textile chemistry, day course, Philadelphia Textile School; also business course.

Experience—3 years as apprentice in weaving mill in Germany, office and stock room, general clerical work, practice in all departments of cotton manufacture, dyeing, bleaching and finishing of cotton-rayon mixtures, piece and package processing; several mos. in laboratory of German dyestuff manufacturer, dyestuffs and assistants and their application, vat and naphthol dyeing.

Age 20; will go anywhere in U. S.

A-B-11

Education: Graduate chemist. Correspond and converse German, some French.

Experience: 3 years dyer; 4 years dyestuff testing, trouble-shooting, purchasing; 4 years demonstrating, consulting, and

supervising for large dyestuff manufacturer. Thoroughly experienced on rayon, cotton, silk, acetates, printing, vats. Fullest references as to character and ability. Seeks position as technician, consultant, or superintendent with reliable dyestuff sales organization or dyehouse. Age 33, married.

A-B-12

Education—Philadelphia Textile School (Evening), Chemistry and Dyeing, Quantitative and Qualitative Analysis.

Experience—Two years in yarn office, making wool stock blends. Last 6 years in dyehouse, 4 years as kettle hand, 2 years in piece dye work. Worked on yarn, raw stock and piece goods; has been dyer on union piece goods, cotton, rayon and wool, leaving wool white; also worked on all wool fabrics and woolen cross dyes; also considerable laboratory experience doing laboratory dyeings and extraction work. Seeks position as dyer or laboratory technician. Age 30; married; references.

A-B-13

Education—B.S., Chemical Engineering, Oregon State College, 1926.

Experience—First experience in dry cleaning plant; few months as sampling and control chemist with potash and chemical company; two years in dry cleaning plant, all phases of work; few months on routine and special analyses, plant problems, special studies and research for gas and electric company; 10 years teaching experience on textile chemistry, dyeing and textile testing covering all general and special courses in this field; consultant work with various mills. Seeks position in textile chemistry or dyeing.

Age 37; married; will go anywhere; references.

A-B-15

Education—Graduate chemistry, dyeing and finishing course, New Bedford Textile School, 1940.

Experience—None. Seeks position in dyeing or finishing departments or in testing (chemical, physical, microscopical).

Age 27; single; references.

A-B-C-4

Education—Educated abroad.

Experience—Twenty years experience in the textile field as bleacher, dyer, finisher and chemist. 16 years in charge of dyestuff laboratory of large dyeing plant, 4 years as chief chemist with large bleachery. Has tested dyestuffs, and chemicals used in the textile field and has manufactured soaps and textile specialties. Has handled all textile fibers; bleaching, printing, dyeing and finishing same. Has done pigment and lacquer printing, waterproofing and fireproofing. Reason for leaving last position was due to business conditions. Age 41; married.

A-B-C-9

Education—Lowell Textile Institute; chemistry, dyeing and textile finishing.

Experience—Twelve years head dyer in hosiery mills. Dyeing all types of fibers and in combination. Knowledge of all dye applications. Matching and formula making. Charge of every department in a nosiery mill except fixing machinery. Has done jigg work on cottons and rayons. Desires position in hosiery, or in any field. Would like to work as an assistant to head dyer in a woolen or rayon mill. Age 42; married. Will go anywhere in the United States.

A-B-C-10

Education—Graduate New Bedford Textile School, 1940.

Seeks position connected with chemistry, dyeing or finishing.

A-B-C-D-1

Education—Lowell Textile Institute, Bachelor of Textile Chemistry; Lowell Textile Institute (Evenings), 2 years D. C. Electricity; 2 years A. C. Electricity.

Experience—Six years as chemist and assistant dyer with a large organization. Specialized in dyeing, finishing, bleaching and drying of woolens, worsteds, cottons, rayons and unions in the piece. Some sales experience. Desires position as chemist, dyer, finisher, bleacher or sales. Age 30; American citizen; Married.

A-B-D-2

Education—Evening courses, chemistry and dyeing, Philadelphia Textile School.

Experience—Eighteen years varied experience as dyer and chemist. Dyeing experience on cotton, wool, shoddy, raw stock, union piece goods, mohair, rayons and alpacca.

Age 37; married; references.

A-B-C-E-1

Education—3 years Chemical Engineer major in college; honor graduate Philadelphia Textile School, chemistry and dyeing course.

Experience—Ten years experience as chemist, colorist, technical director in bleaching, dyeing and finishing of cottons and rayons. Also one year's similar experience in South America. Instructor of textiles and textile chemistry in state vocational school, 2 years. Married; age 32; references; will go anywhere.

A-B-C-F-2

Education—Graduate, Lowell Textile Institute, 1908.

Experience—Over 30 years experience as chemist, color mixer and matcher, foreman printer, foreman dyer on all types of fibers and colors, and finisher. Experience installing complete dyeing and finishing departments. Experience as manager of dyeing and finishing companies. Experience in New York market: interviews with converters, obtaining orders, new customers, settling claims, etc.

Age 51; married, will go anywhere; references.

A-B-C-F-3

Experience—Broad experience since 1906 as overseer of finishing, general researcher, trouble shooter, overseer of dyeing, general superintendent, mill manager. Experienced in woolen, worsted, cottons, unions and mixtures. Recently specialized in men's wear cottons. Seeks position as overseer of finishing or dyeing, assistant superintendent, superintendent or manager.

Age 53, married; references.

B-6

Education—Graduate New Bedford Textile School; also post graduate work in advanced microscopy and rayon testing.

Experience—Five weeks in color shop of print works. Wants position in anything associated with textile chemistry, dyeing, finishing and testing. Single; age 21; references.

B-7

Education—Evening course in chemistry and dyeing at Philadelphia Textile School. Evening course in chemistry at Drexel Institute.

Experience—Started as second hand in dyeworks, then two years as head dyer on women's and children's hosiery. One year as head dyer with other dye works on all types of women's hosiery including Bemberg, rayon and cotton combinations.

Age 26; married; will go anywhere in U. S.; references.

B-8

Experience—20 years' experience with printing companies. Experience as colorist on basics, chromes, Indigosols, vats, rapid fasts, naphthols, Rapidogens and Aridyes. Seeks position as colorist and shader.

Age 49; married; references.

B-9

Education—Graduate of German textile school.

Experience—Twenty-seven years' experience abroad and in this country as chemist, colorist and dyer on cotton, rayon, wool, half-wool, half-silk and silk with various types of dyes and machines. Experience as trouble shooter.

Age 43; married; references.

B-C-1

Education—Two year night course in chemistry, Rhode Island School of Design.

Experience—Nineteen years' experience in printing and finishing plants, in practically every department. Has had direct charge of color shop and practical experience in both peroxide and chemic bleach. Also has had experience as assistant superintendent and superintendent of printing and finishing cotton and rayon piece goods and as company manager in finishing plant.

Age 38; married; references.

B-D-1

Education—General education in England. Chemistry and Dyeing Courses at Huddersfield Technical School.

Experience—Has been a superintendent of dyeing since 1911. Has had experience in worsted mills, hosiery mills and woolen mills. Congenial, sober and reliable. Married; references; age 51

C-1

Experience—1 year as second hand of grey room; 2 years as school teacher; 6 years as overseer of grey room, singeing, desizing and semi-bleach; 5 years overseer of cloth room, finishing and Sanforizing; 1 year night superintendent of mill; 3 years as overseer of grey room, finishing and Sanforizing.

Age 38; married; references; prefers South.

OBITUARY

ARTHUR M. READ

ARTHUR M. READ, who was widely known in the dyeing plants in New England, especially around Providence, died at his home, 101 Wheeler Ave., Cranston, R. I., on May 11th, 1941.

He was born in Providence, R. I. on December 12th, 1876. He became associated with William Pickhardt & Kuttroff in 1895. He had over forty years' contact with the practical application of dyestuffs to textile fibers and accumulated an extensive knowledge of their properties. This knowledge was of great value in serving the General Dyestuff Corporation and its predecessors.

He was a member of the Turks Head Club of Providence and of the Philatec Society. He was a Thirty-second Degree Mason. He is survived by his wife, Mrs. Elizabeth J. T. Read, and two children, Elizabeth T. and Clinton J.

ERNEST J. LEFORT

ERNEST J. LEFORT, technical representative of Ciba Co., Inc., died on May 9th, 1941, at 67 years of age, following a brief illness. His home was in Greensboro, N. C.

Mr. Lefort was born in Montreal, Canada, on November 15th, 1874, and began his textile career in 1895 with Otis Bros. Co. in Ware, Mass. In 1906 be became superintendent of dyeing at White Oak Cotton Mills, Greensboro, N. C. and joined Ciba in 1924. He was widely known for his technical skill throughout the textile industry in the United States and Canada.

He was a past grand knight of the Knights of Columbus and a member of the Benevolent and Protective Order of Elks. He is survived by his wife; three sons, Leo, Adrian and Lieutenant C. R., U.S.A.; three daughters, Marguerite, Mrs. W. M. Gant and Mrs. Harold P. Faust; and one sister, Mrs. Roch Dusseault.

• TEXTILE RESEARCH PROGRAM

After months of study by a special joint committee representing the Textile Foundation and the U. S. Institute for Textile Research, a plan for a broader and more aggressive research program in the textile industry has been developed and put into effect. As announced at the postponed annual meeting of the Institute, the plan calls for a closer association between it and the Foundation. Although remaining completely independent, the two organizations will have a close working arrangement through a common full-time executive. Edward T. Pickard, who has been secretary of the Foundation since its formation in 1930, has been elected executive secretary of the Institute and will devote his full time to the Foundation and the Institute, resigning his position with the U. S. Department of Commerce where for nearly 20 years he has been chief of the Textile Division.

Other officers elected by the Institute at its annual meeting were: Fessenden S. Blanchard, of Pacific Mills, New York, president; Fuller E. Callaway, of Callaway Mills, La Grange, Ga., and Dr. Robert E. Rose, of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., vice-presidents; Dr. Harold DeWitt Smith, of the A. M. Tenney Associates, New York, treasurer.

The special committee which developed the plan was composed of Franklin W. Hobbs, Frank D. Cheney, and Donald Comer, directors of the Foundation, acting for that body, with Mr. Pickard; and Mr. Blanchard, Dr. Rose, Dr. Smith, and Douglas G. Woolf, editor of *Textile World*, acting for the Institute.

The important feature of the new plan is that the Foundation, organized by Congress to promote textile research, will have in the Institute, which is a membership body of technical men and executives in the textile industry, a channel for the transmission of the results of its scientific and economic research to that industry. The Foundation has recognized the desirability of broadening its base of operations as well as the need to more fully inform the textile public of the developments made under its research projects, Mr. Hobbs, chairman, stated in a message to the Institute's meeting. With the new set-up, he added, the Foundation will accelerate and extend its activities, confidently expecting that out of the arrangement with the Institute will be developed a virile organization to carry on textile research when the funds of the Foundation are exhausted, some years hence.

The headquarters of the Foundation will continue in Washington but will be moved to room 225, Industrial Building, National Bureau of Standards. This move will permit of closer administration of the work conducted at the Bureau by 15 Foundation research fellows. Headquarters office of the Institute will be moved from Boston to New York, exact location to be announced shortly. The headquarters office of the Foundation will serve as the Washington branch of the Institute, and vice versa.

The executive committee of the Institute, as named today by the directors, includes in addition to the officers and the chairman of the research council, W. D. Appel, the following: John Bancroft, Jr., Joseph Bancroft & Sons Co.; Earl Constantine, National Association of Hosiery Manufacturers; Alban Eavenson, Eavenson & Levering Co.; Edward R. Schwartz, Massachusetts Institute of Technology; Douglas G. Woolf, editor of *Textile World*.

Directors elected to fill vacancies in the board include: Dr. Smith, Mr. Bancroft, Mr. Callaway, Mr. Constantine; W. M. McLaurine, American Cotton Manufacturers Association; D. H. Powers, Rohm & Haas Co.,; Dr. Rose; Albert C. Walker, Bell Telephone Laboratories; and Mr. Woolf.

The directorate of the Foundation includes, in addition to the three industry members named above, the Secretary of Agriculture, Claude R. Wickard, and the Secretary of Commerce, Jesse H. Jones.

• KOLOK

Chemically riveted men's socks that are claimed to wear up to three times as long as present-day socks were announced recently.

In laboratory tests, pairs of woolen socks treated by the new process survived three and a half months of daily wear for fifteen hours each day, and withstood 90 launderings during the period, before developing a hole. The chemists also say that the new socks eliminate shrinkage almost entirely.

A product of the Development Division of United States Rubber Company, the discovery has been named "Kolok," and will be made available under license to men's hosiery manufacturers. The socks are not yet available for the general public, but production on the necessary scale has already begun and public sale will commence soon when enough advance distribution has been accomplished through the usual hosiery channels, company officials say.

While emphasis in the announcement was placed on men's socks, the process has already been successfully applied to a wide variety of fabrics. These include such things as underwear, flannels, mittens and blankets.

The results announced are achieved by immersing the fabrics in a bath of certain colloidal substances suspended in water. What happens then, the chemists say, is that microscopic particles of the colloidal substances do a job throughout the fabric that can only be described as riveting the fibers in the twisted threads so that they resist wear. It is said that the colloidal particles seem to select for the microscopic riveting the very points where the threads would be most likely to part during use.

In a series of recent tests a number of

pairs of men's socks were used as guinea pigs. One sock in each pair was treated and one sock was not. It is stated that in each case the untreated sock wore out in heel or toe in from 16 to 30 days—with no apparent wear in the treated socks. The treated socks were continued in the test and were worn approximately 15 hours every day for a total of 1350 hours—or 90 days—when the test was officially ended. Thereafter, the test was unofficially continued, and the socks were worn for an additional 16 days—for a total of 106 days—before the first one developed a hole. It is claimed during the 90 days of the official test, the socks were laundered for a new high in launderings—90 times.

Socks used in the test included Army-type socks, cashmere socks, woolen socks and wool-cotton socks. It is stated that the untreated pairs showed a shrinkage up to 25 per cent while the treated shrank only from zero to 4 per cent. There is no difference in the "feel" of the socks, according to the announcement, and verified by those who have seen and handled the socks produced under the process. The socks will dye, and will wash in exactly the same manner as any others.

● SUBSTITUTE FOR TARTAR EMETIC

Pfaltz & Bauer, Inc., Empire State Bldg., New York City, are currently offering a product known as Antim, which is claimed to be an answer to the present scarcity of tartar emetic and to have five advantages:

(1) The fiber assumes a much brighter appearance after mordanting, which leads in the case of prints to purer whites, and favors the production of brighter shades; (2) The brilliance or "fire" and fastness of colors are augmented when mordanted with Antim; (3) It is more readily soluble than tartar emetic; (4) Goods mordanted with Antim draw more slowly in the bath, therefore becoming more evenly dyed; (5) With Antim, the acid liberated is hydrofluoric, recently shown to have less effect on cotton than any other acid.

Complete literature and prices are available.

● DU PONT DYES

Three new dyestuffs have been added to the range of colors offered by the Du Pont Dyestuffs Division.

"Polyform" Bordeaux RF—a formaldehyde after-treated direct color of special interest as a ground shade for colored discharge work both on viscose process rayon and cotton. It yields a deep bluish shade of red, somewhat duller than that of "Pontamine" Diazo Bordeaux RB. Its light fastness, however, is said to be slightly superior to that of the developed color. Rayon dyeings of "Polyform" Bordeaux RF are said to show excellent fastness to washing and perspiration. Dyeings on cotton show slightly inferior resistance.

"Pontamine" Black BCN—a direct color, equal in strength but slightly brighter in shade, and stains acetate rayon somewhat less than the older product, "Seristan" Black B. Fastness to light and perspiration is said to be good and its resistance to washing moderate. It is recommended by the manufacturers for use on cotton materials containing acetate effect threads which need not be pure white. This fiber takes a slight silvery stain that is not considered objectionable. "Pontamine" Black BCN is not suitable for circulating type dyeing machines.

"Pontachrome" Fast Yellow F Conc.—the latest addition to the range of Du Pont chrome colors. It is identical with "Pontachrome" Fast Yellow R in fastness properties but is two and one-half times as strong as the older type. It is of particular interest for men's overcoatings and suitings, and for the production of government olive drab shades, khaki, tan and browns in conjunction with other colors having similar properties. It is said to show good general fastness, being practically unaffected by light, ammonia, fulling, perspiration, hot pressing and laundering. It may be applied to wool rawstock, tops or yarn by the top chrome, chromate and bottom chrome methods, but maximum fastness to wet processing is obtained with the top chrome dyeings. It may be dyed in any of the equipment generally employed for chrome colors as well as in open kettles.

● GENERAL RELEASES

General Dyestuff Corp., 435 Hudson Street, New York City, has released circulars describing the following products:—

Indanthren Grey M3G Paste—recommended by the manufacturers for the dyeing of cotton, rayon and linen in their various forms. It is said to possess very good fastness to light, washing and chlorine. It is said to be especially well suited for the dyeing of greys on cotton piece goods according to the continuous re-reduced padding method, as it does not change its shade in long runs. It is furthermore well adapted for application by the pigment padding process. It is stated that, on account of its good solubility, it may be satisfactorily used in package machines. Circular G-263.

Rapidogen Red FFR—which produces in printing bright shades of red said to be of very good fastness to washing, chlorine and hot pressing. It is said to show a high speed of coupling, being completely developed by a short acid aging. Circular G-258.

● S.O.C.M.A. MEETING

The Synthetic Organic Chemical Manufactures Association held its regular monthly luncheon meeting at the Chemists' Club, New York City, on Thursday, May 15th, 1941. The secretary, C. A. Mace, reported on various items of current interest to the organization.

● FIRE FIGHTING POSTER

"What To Do In Case Of Fire" is told on a new poster just released by Walter Kidde & Company of Bloomfield, New Jersey. It gives brief, concise instructions on how extinguishers should be used on each type of fire. Avoiding technical language, the wall sign gives basic fire fighting facts on carbon dioxide, foam, carbon tetrachloride and water-type extinguishers, tells when each should and should not be used and describes necessary maintenance required by each unit.

The poster is designed for use as an instruction sheet to be posted on bulletin boards as safety posters are used. Some plants have adopted the rule that this wall sign should be hung beside each fire extinguisher in the shops and offices.

Walter Kidde & Company is distributing these posters free, in any quantity, to business or manufacturing concerns which desire them. Simply address your request to the Company at West Street, Bloomfield, New Jersey and posters will be forwarded to you without charge.

● OFFICERS, A.I.C.

Dr. Donald Price, Technical Director of the Organic Research Laboratory of National Oil Products Company, Harrison, N. J., has been elected chairman of the New York Chapter of the American Institute of Chemists for 1941-42. He succeeds Dr. William Howlett Gardner, of Brooklyn Polytechnic Institute.

Dr. Price is well known for his work in synthetic organic and micro-chemistry. He received his Ph.D. from Columbia University and then engaged in research at Trinity College, Cambridge, and the University of Munich. His interest in the field of micro-chemistry dates back to his work in the laboratory of the late Professor Fritz Pregl at Graz, Austria.

Dr. Elmore Northey, of the Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J., was elected vice-chairman, succeeding Prof. W. D. Turner, of Columbia University, in that post.

Dr. Milton Burton, of New York University, takes over the duties of secretary-treasurer from D. H. Jackson, of Croll-Reynolds, Co., New York City.

Dr. Marston L. Hamlin, of the Barrett Co., New York, has been re-elected Chapter Representative on the National Council.

Dr. Joseph J. Mattiello, of the Hilo Varnish Corp., Brooklyn, N. Y.; Dr. R. R. Denslow, of the E. I. du Pont de Nemours Co., Newark, N. J.; and Dr. Byron L. West, of the Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J., were elected to serve as members of the council for the new term.

•TECHNICAL NOTES FROM FOREIGN SOURCES•

New Simple Method of Dyeing Vat Colors Level

Drapal, M. Textilberichte 21, 294, 1940.—There has recently come from the I. G. laboratories a new and simple method of dyeing vat colors on cellulose, for use when there is difficulty in getting penetration and levelness. It is offered particularly for staple fiber (spun rayon) where two of the principal troubles are its great capacity for swelling when wet and its unusually high affinity and high rate of absorption of vat dyes.

Keeping moderately loose while winding, packing, etc., will take care of the swelling but even then the extremely rapid dyeing gives only surface colors and unsatisfactory results.

Methods of dyeing have already been devised to utilize the fact that the color acids of the vat dyes do not have any affinity for cellulose and that the free acid leuco compound can be thoroughly distributed over the fiber, to be fixed then by gradual addition of hydrosulfite and caustic soda to convert it to the sodium salt of the leuco compound. (*M. Textilberichte* 21, 179, *W. Hess*).

There is now a more recently developed method for reducing the affinity of dyes for fiber by dropping the temperature of the dyebath to an unusually low point, then gradually "releasing" the affinity by coming back up in steps or stages, a temperature-step or temperature-stage process.

Methods of controlling dyeing by changes in temperature are about as old as dyeing itself, and it is a familiar procedure to start Indanthrene colors on cotton at low temperatures such as 30-25°C. (86-95°F.) if they tend to exhaust too rapidly when hot. They are then brought up to 60°C. (140°F.) to complete the dyeing. This, however is not sufficient for staple fiber, for which the IN or strong alkali colors have an especially great affinity.

It was found, however, that the affinity for staple fiber can be reduced by going to such unusually low temperatures as 15-20°C. (59-68°F.). Then the leuco compounds of most of the IN colors, the class which gives the most trouble in practical work, will have so low a rate of dyeing that they will distribute evenly over the goods. From that point, in order to fix the dye on the fiber, that is, in order to revive the affinity, it is only necessary to effect a very gradual or a step-wise raise of temperature, up to the optimum for the dye in question. Here the dyeing is continued for another quarter hour and the process completed as usual.

There are no particular technical difficulties but a means for cooling water may be required and a suitable temperature regulator. In general the process is like the usual method for cotton with all dye and chemicals added at the start. Particular care is necessary that the dye is well reduced in concentrated form before adding to the cold dyebath because the IN colors are not well reduced in long cold baths.

Staple fiber is best entered dry. Goods made from cotton or containing cotton must be wet out and cooled. If well enough boiled out they may be entered dry but should also be cool. The main bath is prepared with any desired assistants and a little caustic soda and hydrosulfite, the same amounts as used in dyeing cotton, with ice if necessary for an initial cooling to 13-14°C. (55-57°F.). The color is reduced outside in as concentrated a solution as possible so that its addition to the dyebath will cause the minimum rise of temperature.

The goods are entered and run cold for 15 minutes. The temperature can then be raised at the rate of 1°C. (1.8°F.) per minute but special care is required between 20 and 35°C. (68 and 95°F.). It can then go to 50 or 70°C. (122 or 158°F.), according to the requirements of the individual dye, a little more rapidly. The dyeing is completed with 15 minutes at this temperature and the usual oxidation, etc.

The process gives good results in machine dyeing of staple fiber and mixed goods. It is equally good for producing pastel Indanthrene shades in cotton, and successful dyeing of mercerized yarn is of special interest. Without good circulation local warm spots will cause unevelness. Jig dyeing has not been tried extensively.

Dyeing in short baths may be difficult if low solubility of the dye requires too large a volume of hot solution for reducing it. On the other hand, the process is easy to operate if the dye is very readily soluble and needs only a small volume of warm solution for its reduction.

The method has been tested for a variety of practical work and has given very good results in some difficult cases. It is suitable for practically all Indanthrenes and other vat dyes and their mixtures but is of interest mainly for the hot-dyeing brands. Those of the IK type, which dye cold, and of the IW, which dye at 140°F., do not give any particular trouble even with spun rayon.

In making up compound shades it must be noted that the rates of exhaustion are not all uniformly affected in going down to the low temperature specified, but some (listed in the original article) have a higher rate than the rest. If these are used in compound shades the results will be better if the cold dyeing is run for 30-35 minutes. The original includes some other details and explanations.

Alkali Color Reactions of Azoic Colors Produced from Members of the Naphthol AS Series

W. Bradley — J. Soc. Dyers & Col., 56-296, *July*, 1940.—Insolubility in aqueous alkalies is one of the most characteristic properties of the azoic colors. It has generally been considered that this property cannot be reconciled with the formation of such colors as simple o-hydroxyazo compounds, and numerous alternative ex-

pressions have been proposed from time to time. A view that the azoic colors are quinone-hydrazones, which are neutral in character and therefore incapable of salt formation, is supported by a considerable amount of experimental evidence. Recent developments have led to the conclusion that the special character of the o-hydroxyazo compounds is to be attributed to coordination of hydrogen, a phenomenon which in o- and peri-hydroxyazo dyes is also considered to be responsible for the anamolous absorption spectra of these compounds.

The special properties of many other types of chemical compounds, such as water and cellulose, can be explained most easily in terms of coordination of hydrogen. This phenomenon, which has only recently been recognized as physically possible, serves to explain structural change, as regards the o-hydroxyazo compounds, as the result merely of the movement of electrons, no relative movement of the constituent atomic nuclei amongst themselves being involved. This solution of the structural problem signifies that the alkali-insolubility of certain o-hydroxyazo compounds is essentially a physical phenomenon, since the coordination of hydrogen cannot inhibit salt formation. If salt formation is possible, then it is to be expected that the extent of its occurrence will be determined mainly by (a) the concentration of coloring matter, (b) the concentration of alkali and (c) the hydrolysis constant of the salt in the medium employed. In aqueous solution, and if the degree of hydrolysis is considerable, the amount of salt formed can at most be very small, since the great majority of azo compounds which do not contain either sulfonic or carboxylic acid groups are almost completely insoluble in water. The first requirement for the occurrence of salt formation is thus the selection of a solvent for the azo compound.

Tests were first carried out on benzeneazo-B-naphthol and its p-nitro-derivative by adding a drop of methyl-alcoholic potassium hydroxide to a few ml. of the azo compounds dissolved in various solvents (pyridine, quinoline, nitrobenzene, etc.), the formation of deeply colored alkali-derivatives being observed in the case of more than twenty different solvents. Almost the same effects were obtained when 10 per cent aqueous sodium carbonate was used instead of the alcoholic potassium hydroxide in the case of those solvents (acetone, acetonitrile, pyridine) which are miscible with water. Table 1 records the color reactions which were observed on adding the different alkali solutions to Paranitraniline Red and to benzeneazo-B-naphthol dissolved in various organic solvents.

That deeply colored products are formed from benzeneazo-B-naphthol merely by the addition of aqueous sodium carbonate to solutions of the azo compound in pyridine, acetone, acetonitrile or alcohol is a clear indication that the color changes are the result of salt formation. The question now arises whether the alkali-derivatives are true salts or whether they are coordination compounds. The character of the alkali-derivatives of the o-hydroxyazo compounds depends both on the parent coloring matter and the solvent in which the derivative is formed.

A pale orange 2½ per cent solution of benzeneazo-B-naphthol in toluene becomes deep orange-red in color when an equimolecular proportion of 30 per cent methyl-alcoholic potassium hydroxide is added. Since the product shows no tendency to separate from the solvent even after a lapse of several weeks, it is in this case doubtless a coordination compound. Paranitralinine Red behaves quite differently. A violet flocculent precipitate is immediately formed when the alcoholic potassium hydroxide is added to a solution of the azo compound in toluene, the solvent becoming quite colorless. The violet product is probably a salt—a conclusion which is confirmed by the reaction of the product prepared in a pyridine solution.

An extended examination along similar lines is then made of the color reactions of various naphthol-base combinations and conclusions drawn as to the nature—salt or coordination compound—of the alkali-derivatives formed by carrying out the formation in nitrobenzene. It was expected that a coordination compound would be soluble in this medium, but that a salt might be precipitated after formation. It was actually found that numerous combinations, such as Fast Red TR base—Naphthol AS-LT, Fast Scarlet G base—Naphthol AS-BO, Fast Blue RR base—Naphthol AS, were quickly precipitated upon addition of alcoholic potassium hydroxide to a solution of each in nitrobenzene.

The influence of constitutional factors upon the alkali color reactions of the Naphthol AS combinations is then considered, beginning with the group of simpler azo-B-naphthol pigments. Results are summarized in Table 2, which includes the list of diazotized amines examined, color of the combinations in pyridine and the color changes resulting on adding respectively alcoholic potassium hydroxide and aqueous sodium carbonate.

Closely similar color changes were observed with the corresponding derivatives of Naphthol AS and its simple substitution products. These results are displayed in Table 3, which includes the Fast bases, Naphthols with which the bases are combined, color of the pyridine solutions and colors observed after adding methyl-alcoholic potassium hydroxide. Color reactions of the combinations derived from Naphthols AS-G, AS-LG, AS-L3G and AS-L4G, a special group, are recorded in Table 4.

Tests for Presence of Resin Finishes

H. Rath, Textilberichte 21, 175, 1940. — Following are several tests offered for the detection of "permanent" resins or similar finishes such as intended to withstand washing, to improve the character of goods made from rayon staple, or to produce crease resistance.

Treatment with urea and formaldehyde or with mono- or dimethylol urea results in insoluble carbamid-formaldehyde condensation products which diminish the ability of the fiber to swell. Formaldehyde is liberated by boiling

such finished material with acid or caustic alkali. If not obscured by dye or other color the formaldehyde is detected by adding drop by drop a tenth of one per cent solution of carbazol in concentrated sulfuric acid. If present there is a deep blue color followed by the formation of a blue precipitate upon standing. If necessary, in the presence of interfering color, a distillate can be collected and the test made on that.

There have been patents for such finishes as anticreasing by means of formaldehyde without any form of urea, where a methylene ether is formed with the cellulose. To differentiate this type of finish the test is first applied as described above using acid. If formaldehyde is found it may indicate either type of finish. The test is now repeated using caustic alkali and if there is no reaction for formaldehyde it indicates the second type of finish because the cellulose methylene ether is stable to alkali.

Material dyed with colors aftertreated with formaldehyde will not respond to the test if first stripped with hydrosulfite. If this is done without the use of excessive amounts of alkali or acid the formaldehyde finishes will not be broken down and the tests can be made on the stripped fiber. Naphthols which employ formaldehyde in dyeing lose it during the process and do not respond to the test.

Polymerization products of the ethylene series like polyacrylic acid ester and polyvinyl acetate or mixed esters, are detected by dyeing the sample (after stripping if necessary) with Celliton Fast Yellow RR. Goods finished with such products dye a dark shade which withstands warm soap solution. Other finishes or finished goods are only tinted yellow and the color washes out readily. The dyeing is done at 70°C. for quarter to half an hour.

Separation of Wool and Casein Fiber

Albert Schaeffer in M. Textilberichte 21, 68, 1940.—This is a long article on the identification and quantitative separation of various fibers, most of which is no doubt familiar to those who are interested in the use of such methods. However, the separation of wool and casein fiber by a "new" and "satisfactory" method is described and will be reported briefly.

All methods offered heretofore (February, 1940) for this analysis are unsatisfactory. The method frequently given for a separation by caustic soda, with or without the use of formaldehyde, gives results for the casein fiber which may be too low by 12 to 20 per cent. The usual carbonization method also gives low values, but carbonization of mixtures of wool and casein fiber followed by a short treatment in dilute ammonia gives results which are correct.

One or two grams of the sample to be tested are boiled for 20 minutes in 200 c.c. of aluminum chloride (made up at the rate of 9 grams to 100 c.c. of water), then pressed out, and dried at 100°C. for two or three hours. The carbonized sample is then worked between two sheets of paper to rub the casein fiber to powder. The material is next placed in a fine sieve, rinsed well with hot, then with cold water, and finally put for five minutes into 1.5-2 per cent ammonia (s.g. 0.992-0.990). It is rinsed again with hot and cold water and dried at 105-110°C.

The method is applicable to all casein fibers (known at the time) such as Lanital and Tiolan. The corrected weight of residual wool is 0.98 of the dried weight. The customary regains can be allowed in the final calculation; that of casein fiber is given as 11¼ per cent at 20°C. (68°F.) and 65 per cent relative humidity.

Corduroy—

(Continued from page 298)

terms were homogeneous in the analyses of fabrics 5 through 12. This heterogeneity indicated that the variation in the individual fabrics did not differ from one fabric to another merely in the manner of random sampling.

In an effort to trace the cause of the variability in group 3, these fabrics were divided according to the con-

TABLE 4

Analysis of the count, breaking strength, and weight of new cotton corduroy fabrics

Source of variation	Degrees of freedom	Mean square (variance)				
		Count		Breaking strength (strip)		Weight
		Warp	Filling	Warp	Filling	
Fabric (Group 1—Nos. 1-2)	1	6.40**[1]	156.03**	688.90**	245.02**	0.18
Location	2	2.60*[2]	2.52	6.12	52.00**	0.14
Error	(36	0.68	2.01	3.37	6.26	....
	(16	....	....	....	....	0.04
Fabric (Group 2—Nos. 3-4)	1	9.02**	518.40**	56.40**	2.50	9.25**
Location	2	0.92	0.10	5.88	21.80	.01
Error	(36	0.40	0.77	6.86	17.55	....
	(16	....	....	....	....	0.12
Fabric (Group 3—Nos. 5 through 12)	7	404.36**	627.28**	1,075.04**	1,548.12**	8.90**
Location	8	2.78**	3.59*	7.50	36.50**	0.04
Error	(144	0.59	1.77	6.34	10.46	....
	(64	....	....	....	.....	0.06

[1]A double asterisk indicates the variation exceeds 1 per cent level.
[2]A single asterisk indicates the variation exceeds 5 per cent level.

TABLE 5

Independent fabric comparisons of the count, breaking strength, and weight of new cotton corduroys

Fabric comparisons	Mean square (variance)				
	Count		Breaking strength		Weight
	Warp	Filling	Warp	Filling	
3 versus 4	9.02	518.40	56.41	2.50†	9.25
3, 4, versus 5, 6, 7, 8, 9, 10, 11, 12	7,362.91	1,509.75	9,072.04	7.60†	49.42
5, 6, 7, 8, versus 9, 10, 11, 12	2,648.76	652.06	1,967.01	162.01	3.53
6 versus 7	4.22	3.02†	2,714.26	105.62	0.04†
6, 7 versus 8	3.68	15.41	277.55	418.13	0.40
6, 7, 8 versus 5	126.15	1,876.00	60.50	556.63	0.78
10 versus 11	46.22	36.10	926.41	363.01	3.28
10, 11 versus 9	1.01†	58.80	665.05	36.85	1.32
9, 10, 11 versus 12	0.50†	1,749.60	914.55	9,194.63	52.93

†Variance is less than the 5 per cent level.

struction of the ground weave. This gave two sets of four fabrics; namely, Nos. 5, 6, 7, 8 and Nos. 9, 10, 11, 12. Error variances were not homogeneous for warp count and weight in the first group nor for warp and filling breaking strength and filling count in the latter group of fabrics. Much of the variability within these fabrics for both count and breaking strength may be due to the difficulty encountered in ravelling the strips to one inch.

To eliminate any bias resulting from heterogeneity of error variance and to note individual fabric differences, independent comparisons between fabrics were made for the ten medium-weight corduroys as shown in Table 5. A comparison of v- and w-pile fabrics was made by taking numbers 3 and 4 versus 5 through 12. These groups differed greatly in every property except filling breaking strength. Comparisons within the v-pile group and within the w-pile group showed many significant differences. This indicates not only that the fabrics differed considerably from one another but that the physical tests were sensitive to small differences. Other sets of independent comparisons gave results very similar to those in Table 5.

SPECIFICATIONS

On the basis of these results, the Bureau of Home Economics proposes specifications in order to define the minimum quality of medium-weight cotton corduroy for boys' wear. Since the v- and w-pile fabrics differ in several properties and are easily distinguished from one another, type of pile is used as a means of classification for corduroy. Only two v-pile fabrics were tested, so the following specifications apply to fabrics with w-pile yarns and 11 or 12 ribs to the inch:

Count, minimum, yarns per inch
- Warp 56
- Filling plus pile yarns 136

Weight, minimum, ounces per square yard ... 12.0

Breaking strength, minimum, pounds
- Grab test
  - Warp 78
  - Filling 58
- Raveled strip test
  - Warp 68
  - Filling 44

Shrinkage, maximum, per cent
- Warp 3
- Filling 3

Finishing material, maximum, per cent 10.0

Colorfastness to laundering,
- A.S.T.M. designation: D435-37 ..... Satisfactory

Colorfastness to light after 40 hours, minimum. Class 3

These proposed requirements are at present under consideration as Tentative Specifications by Sub-committee A-6 of the American Society for Testing Materials.

REFERENCES

[1]National Bureau of Standards. Woven dress fabrics; testing and reporting. Commercial Standard CS 59-39, 1939, 27 pp.

[2]American Society for Testing Materials. A.S.T.M. Standards on textile materials, 1939, 324 pp., illus. Philadelphia.

[3]Snedecor, George W. Statistical methods, 1938, 378 pp., illus. Collegiate Press, Inc., Ames, Iowa (pp. 206-207).

• CLASSIFIED • ADVERTISEMENTS

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Practical Dyer, Finisher and Textile Chemist. Wide experience in cotton, rayon and mixed fabrics. Also fast color work including Vats and Napthols. Write Box No. 307, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

DRAPEOMETER: New instrument for sale. Attractive price. Write Box No. 317, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Dye House Superintendent. Well grounded technically and in experience with wide ranges of colors, fabrics and finishes. Must be an executive and progressive, to manage large plant. Write giving full particulars including salary and picture. Box No. 318, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.